Legislative History
Committee Publication No. 92-10

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COMMITTEE PRINT
THE ISSUES RELATED TO SURFACE MINING A SUMMARY REVIEW, WITH SELECTED READINGS
COMMITTEE ON INTERIOR AND INSULAR AFFAIRS UNITED STATES SENATE
92nd CONGRESS, 1ST SESSION
DECEMBER 1971 SERIAL-NO: Serial No. 92-10

MEMORANDUM OF THE CHAIRMAN

{2} To members and ex officio members of the Senate Committee on Interior and Insular affairs, pursuant to Senate Resolution 45, a national fuels and energy policy study

2 The decisions and the management philosophy underlying the uses we make of the Nation's limited land and mineral resource base - the endowment of present and future generations - have come to be viewed as a key element in determining the quality of the life of our Nation.

2 Important progress has been made in many areas in recent years as a result of new Federal initiatives in the area of environmental management, including the balancing and review process established by the National Environmental Policy Act of 1970. Concomitant with the goals declared in the National Environmental Policy Act are the goals of the National Mining and Minerals Policy Act of 1970 which states that the national interest is served by fostering and encouraging the development of an economically sound and stable domestic mining industry. The Senate Interior Committee has played an important role in awakening public interest in land use policy as the key institutional device for shaping the future, and in recognizing the goals of the National Mining and Minerals Policy Act as a part of that future.

2 The series of hearings chaired by Senator Frank E. Moss, Chairman of the Subcommittee on Mining, Materials, and Fuels, on the pending legislative measures to control and regulate surface mining have served to focus national

attention upon an important and integral part of our total land use considerations.

2 The pending surface mining measures raise many important issues. Some relate to the sufficiency of the Nation's energy resource base and industrial system to provide environmentally clean energy in the form the public needs. Others concern problems of acid mine drainage, treatment of highwalls, the handling of refuse and overburden materials which are a source of pollution, and the bleak and barren landscapes which are too often left unreclaimed in the wake of surface mine operations. Too often overlooked and therefore usually not considered in discussions of surface mining regulation is the environmental impact of water pollution from underground mining, acid mine drainage, subsidence and ugly tailing piles. Of even more serious concern is the tragic and appallingly high loss of life and the intolerable accident rates associated with underground coal mining - the major alternative to surface coal mining practices.

2 Many other issues associated with surface mine legislation are also of major policy significance. These include:

2 Important questions as to Federal-State relationships and responsibilities;

2 Who should pay the costs to correct past abuse;

2 What Federal agency should administer the program;

2 The timetable for implementation of Federal regulations;

{3} The consideration of sanctions for noncompliance;

3 The adequacy of surface mine reclamation knowledge, techniques, and management practices; and

3 The imposition of uniform Federal and/or State severance taxes.

3 As a nation, we can no longer accept the social and environmental costs imposed by some past surface mining practices. These costs, estimated in 1967 at $1 .2 billion, are real and pose a serious national problem. Their resolution will require a national policy that is balanced yet firm; that recognizes the widely different circumstances and problems involved in different kinds of mining operations and in differing regions across the land; that protects private as well as public lands from abuse; and that is capable of incorporating new technological concepts to improve environmental standards so that the social and environmental costs of surface mining are mitigated.

3 Mr. George H. Siehl of the Environmental Policy Division of the Congressional Research Service, Library of Congress, at my request has prepared a report summarizing some of the major issues related to surface mining legislation and a compilation of excerpts from the current literature and the testimony from the hearings. This material will be of significant assistance to the committee and others in analyzing the issues presented in the pending bills.

3 I have directed, therefore, that Mr. Siehl's paper be reproduced as a committee print so that it will be readily available to members of the committee and other interested parties.

3 HENRY M. JACKSON, Chairman.

LETTER OF TRANSMITTAL

{4} THE LIBRARY OF CONGRESS, CONGRESSIONAL RESEARCH SERVICE, Washington,
D.C., December 27, 1971.

4 Hon. HENRY JACKSON, Chairman, Senate Committee on Interior and Insular Affairs, U.S. Senate, Washington, D.C.

4 Dear MR. CHAIRMAN: I am pleased to transmit herewith a report "The Issues Related to Surface Mining" prepared at your request by Mr. George H. Siehl, analyst in our Environmental Policy Division. We have drawn these issues from a review of the extensive literature on the topic, and from hearings on surface mining proposals which were held by your committee on November 16 and 17, and December 2, 1971.

4 Also included is a selection of recent readings which illustrate in some detail the issues which have been identified.

4 Sincerely yours, LESTER S. JAYSON, Director.

INTRODUCTION

{5} KEY ISSUES IN SURFACE MINING FROM THE LITERATURE

5 For a period of 30 years the Congress has had before it legislative proposals bearing on the recovery of various minerals by surface mining. A history of these bills was contained in a Committee Print issued earlier this year by this Committee. n1

5 n1 Legislative Proposals Concerning Surface Mining of Coal. 92nd Congress. 1st Session, Committee on Interior and Insular Affairs, United States Senate. September 1, 1971.

5 Surface mining refers to the process of removing the soil, rock and other material which covers the mineral, e.g. strip mining, open cast mining, placer or hydraulic mining, quarrying, and dredging.

5 A related method, used in the recovery of coal, is auger mining, a process in which large drills are used to bore horizontially into coal seams on hillsides.

5 An Interior Department study, "Surface Mining and Our Environment", has identified these advantages of surface mining methods:

5 It makes possible the recovery of deposits which, for physical reasons, cannot be mined underground; provides safer working conditions; usually results in a more complete recovery of the deposit; and, most significantly it is generally cheaper in terms of cost-per-unit of production.

5 Surface mining is of great importance in our domestic mining industry, as illustrated by recent remarks of Interior Secretary Morton to the Interstate Mining Compact Commission in which he noted:

5 Surface mining in 1969 accounted for 94 percent of all domestic production of crude metallic and nonmetallic ores: 2.45 billion tons compared with 165 million tons from underground mines.

5 Approximately 38 percent of all coal in 1969 came from surface mines. Preliminary data for 1970 indicates that this figure has risen sharply to 44 percent.

5 On a comparison basis, surface mines in 1969 produced 218 million tons and 269 million tons in 1970. Underground mines produced 347 million tons in 1969 compared with 338 million tons in 1970. Only the sharp increase in surface-mined coal enabled the industry to meet demand last year.

5 A more detailed picture is presented by the tables in the reader section of this Committee Print which show the production of various commodities by surface mining. Tables are included under the heading on Natural Resource and Energy Requirements.

5 Another study has recently noted these characteristics of coal surface mining operations:

5 In strip mining, output per man-day is roughly 100 percent higher than in underground mining, average recovery is 60 percent higher, and operating costs are 25-30 percent lower.

5 This report, "Stripping Coal Resources of the United States" by Paul Averitt of the U.S. Geological Survey shows the increased efficiency of recovery made possible by strip mining methods. A Pennsylvania anthracite field, for instance, saw only one-third recovery by underground mining years ago. In the 1920's and 1930's strip mining with small shovels increased the recovery. Now partly mined coal is being recovered by surface mining methods in pits as much as 400 feet deep.

{6} Averitt indicates that by 1980 the pits may reach a depth of 1,000 feet.

6 Despite the magnitude and value of surface mining operations some Members of Congress and other concerned citizens feel the adverse environmental effects of surface mining are so severe in the case of coal that they seek a total ban on all coal strip mining. Other bills have sought to ensure a nationwide system of State, Federal or a combination of State and Federal control of surface mining which would, among other things, require the restoration of lands to be disturbed by surface mining. Some of the proposed bills provide reclamation of lands already disturbed.

6 It was estimated that some 3.2 million acres had been disturbed by surface mining as of January 1, 1965. Of this total, some "two-thirds of the acreage (about 2.0 million) still require some remedial attention", according to the 1967 Interior Department report.

6 One serious deficiency in working with the problem of land reclamation is the lack of adequate current statistics on the amount of land disturbed and restored since the 1965 information was published. The Bureau of Mines, which compiles national mineral industry statistics has released the following figures only for 1969 and only for coal, although it is understood that later figures are being gathered and will be made available:

SALIENT STATISTICS ON SURFACE MINING OF COAL IN THE UNITED STATES, IN 1969 n1

	Production		Surface mined land		
State	Number of mines	Quantity (thousand short tons)	Acreage disturbed	Acreage reclaimed	Percent of disturbed land reclaimed during year
Alabama	65	8,169	n(2)	n(2)	n(2)
Alaska n3	3	667	15		
Arkansas	6	167	n(3)	n(3)	n(2)
Colorado	9	1,915	n(3)	n(3)	n(3)
Illinois	37	34,640	6,711	5,479	81.6
Indiana	32	17,976	3,33 5	3,118	93.5
Iowa	11	534	120	40	33.3
Kansas	4	1,313	1,176	250	21.3

Kentucky:					
Eastern	262	17,082	12,200	9,600	78.7
Western	51	27,632	12,200	9,600	78.7
Maryland	38	1,045	261	459	175.9
Missouri n3	8	3,299	n(2)	n(2)	n(2)
Montana	5	995	31	33	106.5
New Mexico n3	3	3,636	250	100	40.0
North Dakota	20	4,704	330	140	42.4
Ohio	276	32,616	10,629	7,902	74.3
Oklahoma	8	1,722	1,674	1,441	86.1
Pennsylvania:					
Bituminous	602	22,592	11, 774	9,298	79.0
Anthracite	174	4,579	534	539	100.9
Tennessee	73	3,609	n(2)	n(2)	n(2)
Virginia	158	5,182	2,258	2,331	103.2
Washington	2	5	n(2)	n(2)	n(2)
West Virginia	340	19,388	15,711	17,117	108.9
Wyoming	8	4,481	154	51	33.1
Total n4	2,195	217,952	67,163	57,898	86.2

6 n1 Data on acreage disturbed and acreage reclaimed compiled from Bureau of Mines form O.M.B. No. 42-S70014.

6 n2 Data not reported.

6 n3 No State regulation on surface mining.

6 n4 Data may not add to totals shown because of rounding.

{3} On the unreclaimed surface mined site there is destruction of the vegetative cover; the overburden is strewn upon adjacent lands; and surface and subsurface drainage patterns are altered. The 1967 Interior report notes these additional offsite damages:

3 Stream and water-impoundment pollution from erosion and acid mine water; isolation of areas by steep highwalls; and, the impairment of natural beauty by the creation of unsightly spoil banks, rubbish dumps, and abandoned equipment.

3 An important loss from unreclaimed lands is the fish and wildlife which the affected area would have supported in its natural condition.

3 Only seven commodities have been identified as being responsible for 95 percent of the 5,000 square miles which have been disturbed by surface mining. They are:

	Percent
Coal	41

Sand and gravel	26
Stone 8 percent, gold 6 percent, clay 3 percent, phosphate 6 percent, iron 5 percent	28
All others	05

3 These figures explain, perhaps, the prominence given to coal in the public discussion of problems related to surface mining. A contributing factor must also be the fact that coal mining is conducted largely in the East where it is visible to a larger portion of the population than is the case with Western mines which are primarily for metallic ores.

3 Although the prime arguments over legislation to regulate surface mining are economic and environmental, there are a number of additional points of controversy. These include the need for continuing supplies of minerals, particularly coal because of the current concern over energy supplies; and the effectiveness of reclamation procedures. The question of who shall administer regulation programs, and the safety of mine workers are also of concern. Briefly, the contentions over these matters are as follows.

3 The energy crisis

3 The Senate Interior Committee has been particularly cognizant of the mounting public concern over the continued availability of adequate energy supplies. Recent evidences of action in this matter are the establishment of a National Fuels and Energy Policy Study pursuant to Senate Resolution 45 of the 92nd Congress, action by the Committee on S. 1846, to develop an accelerated program of coal gasification, and a review of the Department of Interior's prototype leasing program for oil shale.

3 Estimates of major energy sources in the period beyond the year 2000 indicate that fossil sources will decline in importance. Until that time, however, fossil fuels must be considered our primary energy source. Of those fossil fuels - coal, oil and gas - coal is the most abundant and the most accessible. The major use of coal is in the generation of electricity.

3 The 1970 edition of Mineral Facts and Problems published by the Bureau of Mines notes:

3 Increasingly, environmental and social considerations can be expected to constrain the supply and limit the use of direct fuels to those that are nonpollutant. Land use and ecological considerations may restrict strippable coal supply.

3 Environmentalists have advocated constraint in the use of energy generally, and strip mined coal in particular, on the theory that our current

level of electrical power use is needlessly high. Power companies have also been criticized for extensive advertising to generate additional consumer demand for power. Major portions of the U.S. coal reserves are recoverable only by surface mining techniques. Satisfaction of electric power demands without access to these coal deposits would add a new and significant dimension to the energy crisis.

{4} } Our need for non-fuel minerals has been presented as largely a choice between surface mining for domestic reserves or dependence on foreign sources of supply. Interior Secertary Morton in his remarks to the Interstate Mining Commission declared:

4 It is the surface mining industry that, in the future, will provide a strong domestic mineral supply base and prevent our dependence on foreign sources of mineral raw materials from becoming dangerously large or prohibitively expensive.

4 Reclamation feasibility

4 The capability adequately to restore surface mined lands using available technology is a matter which is still under debate. While industry has returned to productive use some thousands of acres of mined land, opponents claim that, in the main, these are simply "showcase" projects which are not representative of the vast majority of reclamation efforts.

4 State-by-State statistics and examples of reclamation efforts by the coal industry in 1970 are contained in the reader portion of this document under the heading "Reclamation."

4 Although existing State laws require land rehabilitation, opponents of surface mining have claimed that the requirements are not rigid enough to provide environmental protection, or that there is little or no enforcement of the provisions.

4 Federal or State regulation

4 A major question concerning the regulation of surface mining has been whether the Federal or State government should establish and operate the program.

4 State regulation has been favored by the mining industry on the grounds that local unique conditions could be more easily recognized and built into the regulatory program. An overall Federal program, it was claimed, would be too inflexible and would work a disadvantage on some surface mining operations.

4 Proponents of a Federal program criticize the lack of strong regulations

and enforcement under State management. They cite as an additional argument that, with uniform nationwide standards and requirements, unscrupulous surface mine operators would not be able to move from State to State, in effect, "shopping" for the lowest standards of environmental protection.

4 Wayne Davis wrote in his article "The Stripmining of America":

4 As the acceleration of stripmining proceeds, attempts to regulate it are frustrated. Although Kentucky has a fairly good mining reclamation law and some honest, conscientious people in the Division of Reclamation, law enforcement has broken down. An employee of the Division told me that during the summer of 1970 permits were issued to over 100 new operators. Since anyone who can borrow enough to get a bulldozer into operation can go into business and get rich now, there is a flood of new people into stripmining. The enforcement officer said that some of these inexperienced operators could not operate within the law even if trying to do so and spills of spoil onto public highways and into the streams are the result.

{5} Davis added:

5 * * * We must have federal regulations of mining practices. Any local efforts to regulate this or any other industry encounter the standard and somewhat justified reply that regulation would put them at a disadvantage with their competitors in other states.

5 Edmund Faltermayer has examined the strip mine reclamation requirements and operations in Pennsylvania, and in Life magazine expressed a strongly contrary opinion. After commenting on the several State and Federal proposals to ban strip mining of coal he writes:

5 * * * It costs $1 .50 a ton less, on the average, to strip coal than to send men into the bowels of the earth for it. That cost advantage is so great that stripmining companes can afford to do some pretty fancy regrooming if they are made to do it. I know this is so, because I've been to Pennsylvania, a state which rigorously enforces its reclamation law, the toughest in the land. A lot of Pennsylvania companies are now going beyond what the law requires - replacing topsoil, for example. "They've really got religion on reclamation now," says William E Guckert, who runs the states' enforcement program. "But," he quickly adds, "they didn't get religion until we put the screws to them."

5 Cynics will greet with disbelief the news that there is a state government anywhere that puts the screws to the strip-mining industry. How it happened is worth telling. With more scarred acreage than any other state.Pennsylvania also has the country's biggest constituency of outdoorsmen to notice all the ruined terrain - 1.1 million licensed hunters and 800,000 fishermen - and they know how to lobby.

5 Both of these articles appear in their entirety in the later pages of this committee print.

5 Several of the pending bills combine Federal and State roles in regulating surface mining. The Federal responsibility lies in formulating general guidelines within which the States are to develop and enforce reclamation programs. In the event a State does not do so, the Federal Government is empowered to develop and or administer a program deemed satisfactory by the Secretary of the Interior.

5 Worker safety

5 An important social issue which had been discussed with regard to the relative merits of underground and surface mining is the health and safety of the miners.

5 Mr. Harry Perry, Senior Specialist for the Congressional Research Service, has stated:

5 * * * The fatality and injury rate in underground mines is much higher than for strip mines. In 1970 the fatality rate in underground mines was 1.17 per million man hours of exposure while it was only .64 for strip mines. If all coal stripping were banned and the fatality rates remained as they now are the conversion to all underground mining would indicate statistically 90 additional men killed in mining for 1970.

5 Strip mine opponents have contended that rigorous enforcement of the 1969 Mine Health and Safety Act would do much to reduce the hazards of underground mining

SELECTED READINGS:

GENERAL

{19} [From New York Times, Aug. 22, 1971]

19 COAL RUSH IS ON AS STRIP MINING SPREADS INTO WEST

19 (By Ben A. Franklin)

19 WASHINGTON, Aug. 21 - A new stage in the development of the American West is beginning on the arid plains and badlands that flank both slopes of the Rocky Mountains.

19 On thousands of square miles of vacant land west of the Mississippi -

much of it in Federal ownership or in Government land grants to Indian tribes and railroads - a feverish coal rush is on.

19 The scramble is for coal leases and rights that will open an enormous and virtually untapped reserve of cheap Western fuel to strip mining.

19 On a scale far larger than anything seen in the East, where acreage totaling half the area of New Jersey has been peeled off for coal near enough to the surface to be strip mined, portions of six Western states - Arizona, Colorado, Montana, New Mexico, North Dakota and Wyoming - face a topographic and environmental upheaval.

19 It is being brought on by the nation's apparently insatiable demand for energy, by the air pollution crisis in urban centers, by new technology in the conversion of coal to clean fuels, and by the economies of bulldozing rather than tunneling for coal that are available in the West.

19 In resolving the energy and air pollution problems, however vast areas of isolated open spaces in the West may be drastically altered.

19 The visual impact of strip mining is invariably stunning. On flat or rolling terrain, mammoth power shovels crawl day and night through great trenches, lifting, wheeling and depositing, the unwanted strata above the coal seam into thousands of uninterrupted acres of geometrically perfect windrows of spoil banks.

19 In mountain coalfields where one, two or as many as five seams may lie horizontally through timbered slopes far above the valley bottom, the contour strip mines are notched in continuous, sinuous strips around the mountainsides. Trees and earth and rock are cast down the mountain flanks to expose the strippable edge of the coal bed.

19 The legacy of upheaval remains. Silt fills streams for thousands of miles.Sulphurbearing coal, left in place and exposed to the elements, yields a long-lasting trickle of sulphuric acid which chemically burns streams and kills aquatic life. From the air over a "hot" acidic strip mine, pools of rainwater glow in weird shades of red and orange.

19 The debate over strip mining has been gathering since the late nineteen-fifties, when larger and larger earth-moving machinery made its growth economically feasible and gave it a cost advantage over underground mining. With a passion that coal men tend to see as mysticism, conservationsts say that stripping destroys the very roots of men's souls - the land. The mining industry sees it with similarly strong conviction as the best way to tap a vital national resource which, as one strip mining executive put it recently, "God put there for man's use - it's a sin to waste it."

19 According to one Government geologist here, the six states and others in the West - Oklahoma, Texas and even a patch of Washington State - "are on the brink of, not years, but generations of strip mining for coal that will make the excavation for the Panama Canal look like a furrow in my backyard vegetable garden."

19 The first wave has begun. In 1970, for the first time in the 100-year history of coal mining in America, a Western mine - the Navajo strip mine of the Utah Construction and Mining Company near Farmington, N.M. - became the largest single producer in the country. Its output from Indian coal lands was more than six million tons for the Four Corners Electric Power Complex, an environmentally controversial steam-electric station serving New Mexico, Arizona, Nevada and Southern California.

{20} Near Centralia, Wash., 30 miles south of Olympia and just beyond the foothills of Mount Rainer, a 5,000-acre, 135-million ton deposit of coal that was only nibbled at by tunneling from 1870 into the nineteen-fifties for pre-diesel locomotive fuel for the Northern Pacific and Union Pacific Railroads, is being turned into one of the biggest strip mines in the country. The planned rate of production is five million tons a year for a 700,000 kilowatt generating station of the Pacific Power and Light Company and the Washington Waterpower Company.

20 Pacific Power and Light also owns rights to an estimated 1.6 billion tons of strip mine reserves in Wyoming and Montana. The company expects to rank among the top fine coal producers in the country by 1977 with production of 23 million tons a year. Its president has said that the company will go slow on expensive investment in nuclear power stations because "we've got coal running out our ears."

20 Even Texas lignite - lignite is the lowest rank of coal in energy per ton and it has never generated more than an asterisk in Government coal production statistics - is having a sudden boom.

20 Three electric utilities - Texas Power and Light, Dallas Power and Light and Texas Electrical Service, Inc. - announced two months ago that they would begin a 35-year strip mine operation on 17,500 acres of lignite beds in Freestone County, near Fairfield, to fuel the new Big Brown steam-electric station east of Waco. Other lignite-fired plants are scheduled for Rusk and Titus Counties.

20 Western coal is low in sulphur - a boon to electric utilities caught between soaring power demand and new air pollution regulations that forbid the burning of sulphur-contaminated fuel. Accordingly, also for the first time last year, some low-sulphur western coal was hauled by rail as far east as Chicago.

20 But according to Government coal men, an immense strip mine explosion west of the Mississippi River that, by comparison, will make this excavation for electric power stations look like a mere desert gulch, is coming in the nineteen eighties for a giant new coal consuming industry, gasification.

20 Officials forecasts here say that 20 years from now perhaps 300 million tons of coal a year - half of last year's total United States production - will be processed at huge, refinery-like plants, surrounded by massive strip mines in the Western coal fields. The product will be quadrillions of cubic feet of pipeline quality, pollution-free gas. The Government and the mining and gas industries are now committed to this basic change.

20 VAST COAL BEDS IN WEST

20 Coal gasification will replace the country's dwindling supply of natural gas from wells, now estimated to be only about a 15-year reserve. Consumed in power plant and industrial boilers in the East, the gas will reduce air pollution. And pumped through pipelines that might otherwise be empty, it will save the pipeline industry from collapse.

20 Millions, perhaps billions, of dollars are thus finally ripening in coal beds under Western sagebrush, where the mineral has lain for geologic time, 130 million years.

20 The speculative market in Western strip mine leases to dig it, and in permits to explore for more, has suddenly become a bonanza.

20 In the 12 months that ended in July, 1970, the increase in prospecting permits issued by the Interior Department's Bureau of Land Management for coal exploration on Federal land - national forests, grassland, desert and range - shot up by 50 percent to the greatest number in history, covering 733,576 acres. That is the area of all New York City and Long Island, with Westchester and Rockland counties thrown in.

20 Prospecting permits on Indian reservations, issued separately by the Bureau of Indian Affairs, went from none to exploration rights covering 500,000 more acres. Such permits are convertible to firm mineral leases if coal is found.

20 COAL-FIRED TURBINES

20 Nearly one million acres of public and Indian coal land in the West is already leased. Leases by private owners, chiefly by the transcontinental, land-grant railroads, are unknown but may cover an equal area.

20 The forces behind the sudden migration of coal mining to the West are complex, and the reasons for them are probably as irresistible as money.

20 First, despite the wide acceptance during the nineteen-sixties of visionary forecasts for nuclear electric power, half the nation's electricity is still generated by coal-fired steam turbines.

{21} Dr. Glenn T. Seaborg, the retiring chairman, of the Atomic Energy Commission, recently conceded that the poor record of the A.E.C.'s vaunted nuclear-electric program means that coal will fuel an even greater portion of the enlarged generating capacity required for the next three decades.

21 Other important factors are mining costs and mining volume.

21 Strip mine production of coal in the country as a whole has advanced very rapidly in the last few years, from about one-third of the annual tonnage in 1968 to 40 or 42 per cent last year. According to the United States Bureau of Mines, the cost advantage over deep mined coal is on the order of three to one.

21 Productivity per worker runs as high as five to one in favor of strip mining, and is going higher under the Federal Coal Mine Health and Safety Act of 1969, which requires deep mines to take expensive steps to curb the high rate of death and injury underground.

21 Moreover, particularly for gasification, huge guaranteed volumes of cheap, strip-mined coal are essential.

21 77 PERCENT OF RESERVE

21 The Bureau of Mines has just cautiously disclosed in an unpublished compendium that beneath 13 states west of the Mississippi River there lies 77 percent of the country's total of economically strippable coal reserves of 45 billion tons. The Western coal is in seams 12 times thicker, on the average, than in the East. And 25.5 billion tons of it is low-sulphur coal.

21 Wyoming and Montana, together, contain 21 billion tons of the entire Western reserve of low-sulphur coal. Wyoming's low-sulphur reserve, alone, is eight times West Virginia's and Kentucky's put together.

21 The Government has apparently pre-empted most of one of Colorado's major strip mine fields by building the Air Force Academy on top of it at Colorado Springs.But Colorado still contains nearly half a billion tons of the highest grade of low-sulphur strip mine coal.

21 And still undisturbed beneath the wheat and grasslands of western North Dakota wait 50 billion tons of lignite - the leanest rank of coal, but

equivalent in total energy to all the better grades of coal left to be mined in the four largest producing states, West Virginia, Kentucky, Pennsylvania and Illinois.

21 The Bureau of Mines has recently disclosed that Pennsylvania and Illinois have no low-sulphur stripping coal left at all. *the reserve in West Virginia is only about 1.2 billion tons, one twenty-fifth of the national reserve.

21 For a hundred years the traditional coal field regions of the United States have been there - in the Appalachian east and south and across southern Indiana and Illinois, tapering off into Missouri, Kansas and eastern Oklahoma.

21 Billions of tons of coal and billions of dollars of investment in immovable tools and tunnels remain in these traditional coal areas, and depletion of total coal reserves is not the most important factor in the move to the West.

21 But although the Eastern and Midwestern fields now supply 94 per cent of the 600 million ton-a-year coal production, they contain only 17 per cent of the remaining reserve of strippable low-sulphur coal.

21 ENERGY SYSTEM SHIFTING

21 It is this arcane statistic, the 83 per cent of shallow, strippable, low-sulphur coal beneath the Western states, that is starting what the United States Geological Survey calls "a massive change" in the whole national fuel and energy system.

21 Until the air pollution crisis of the nineteen sixties and seventies the West's low-sulphur coal was as worthless as a coyote. Coal is the cheapest of fossil fuels and, accordingly, freight is a large part in its cost to consumers.Longhaul reserves were not cost-competitive.

21 But now that many urban pollution abatement laws forbid the burning of coal or oil containing more than 1 per cent sulphur by weight - and the Federal Environmental Protection Agency has said the limit may have to be pushed to 0.7 per cent - the ancient economic maxims of coal, a $3-billion a year industry, are caving in.

21 Already, in a break with transportation tradition, the historic flow of coal from Appalachian mines to Lake Erie port to docks at Superior, Wis., or Duluth, Minn., has begun to turn around.

{22} For example, Burlington Northern, Inc., the merged railway system - and also one of the largest private owners of Western coal reserves through 19th century Federal land grants - has been loading low sulphur coal from the Peabody

Coal Company's Big Sky strip mine at Colstrip in eastern Montana. The coal goes by train to the docks at Superior and is shipped lake steamer to Tasonit Harbor, Mich., a movement that would have been economically unthinkable a few years ago.

22 It is the prospect, however, of prodigious volumes of stripmined coal to supply gasification plants that lies behind the frantic scramble by coal, petroleum and pipeline interests - and by land brokers and speculators who expect to profit at their expense - to assemble leases and rights to large tracts of Western coal for future stripping.

22 The scope of this Western stripping for gasification - large both on a plant-by-plant basis and also in the area to be affected by big new surface mines - is suggested by what the American Gas Association calls its "very confidential" study of potential gasification sites.

22 Apparently for fear of stimulating price gouging in mineral leases and arousing conservationist opposition, the association will not discuss the study beyond acknowledging its existence. Association officials will not even say which states have been identified as gasification sites, much less which counties.

22 But it is known that the association report pinpoints 176 prospective plant locations - each to require a $200-million to $3 00-million investment in strip mine and coal processing facilities - and industry officials say variously that "a large majority" or "nearly all" of them lie west of the Mississippi.

22 A Government geologist who has seen the association study says that 156 of the 176 sites - all but 20 - are in "the Rocky Mountain West." Enough of them are to be developed by 1985, the study suggests, so that gasification by then will materialize as a $1-billion-a-year industry on the West's open spaces.

22 According to Interior Department reports, coal for future gasification is spurring recent transactions like these:

22 In response to a United States Bureau of Land Management invitation to bid on 6,560 acres of Federally owned coal land in Campbell County near Gillette, Wyo. - the bureau delicately described the 10-square-mile area as "susceptibleto stripping" - the Cordero Mining Company won the coal leases with a record high price of $5 05 an acre. In recent years, some Federal coal leases have gone for under $1 an acre. Cordero is a subsidiary of the Sun Oil Company.

22 On the same day last December, the Mobil Oil Company bid $4 41 an acre for leases on 4,000 acres of bureau land adjoining the Cordero site. The United States Geological Survey had estimated its worth at $35 an acre.

22 LEASE PRICES SOAR

22 Bureau lease prices have advanced so rapidly that a short time earlier a successful bid of $2 57.50 an acre by a land-buying affiliate of the Ashland Oil Company - $1 .9 million for coal rights to 7,600 acres, or 13 square miles, of Carbon County near Hanna, Wyo. - was being called a "precedent-shattering high price." The $2 57.50 precedent lasted two weeks, when Cordero doubled it.

22 But particularly on Indian reservations, there have also been what one official of the Bureau of Indian Affairs here calls "some damn lucky breaks" for Eastern coal companies bidding for leases of tribal coal reserves.

22 Last September, Westmoreland Resources, Inc., a year-old Western strip mining partnership of the Philadelphia-based Westmoreland Coal Company, Penn Virginia, Inc., the Kewanee Oil Company, the Morrison-Knudson Company, and the Kemmerer Coal Company of Wyoming, had to bid an average of only $7 .87 an acre for 32,300 acres of coal rights held by the Crow Indian reservation in the Sarpy Creek area of Treasure and Big Horn Counties, Mont.

22 Within months, the syndicate had sold options to buy 300 million of its 900 million tons of Montana coal reserves to the Colorado Interstate Gas Company, the pipeline division of the Colorado Interstate Corporation. The company is a major pipeline company and may be one of the first to erect a coal gasification plant, presumably near Hardin, Mont.

{23} OTHER VAST RESERVES

23 Other vast coal reserves in the West are owned by the railroads. Government land grants to the railroads, which were originally meant to encourage and finance the construction of track to the West but which have remained dormant and unsalable for 100 years, are suddenly valuable.

23 The Union Pacific, for example, has become a profitable lessor of its 10-billionton to 12-billion-ton reserve of coal on land given the company by the Federal Government under the railroad land grants of the last century.

23 But by far the greatest acreage of coal leaseholds is being acquired on speculation for later sale to the coal gasification industry.

23 An unpublished "working paper" prepared at the Interior Department shows that the 10 largest holders of Federal coal leases control 49 percent of the 773,000 acres of public domain turned over to mining interests or land speculators as of July 1, 1970, and that very little of their acreage is being mined. Some of the inactive leases have been held at little cost since the nineteen-twenties but most are about five years old.

23 The 10 largest lease holders, in order of the acreage of their coal

rights, are listed as the Peabody Coal Company; the Atlantic Richfield Company; the Garland Coal and Mining Company; the Pacific Power & Light Company; the Consolidation Coal Company; the Resources Company; the Kemmerrer Coal Company; the Utah Construction and Mining Company; Richard D. Bass, a Dallas geologist and land investor, and the Kerr McGee Corporation.

23 DRASTIC CHANGE SEEN

23 The Interior study says that, of all the Federal coal acreage under lease, those 10 lease holders control 97 percent of the leases in Montana and North Dakota, 91 percent in New Mexico and Oklahoma, 79 percent in Utah, 75 percent in Colorado and 77 percent in Wyoming. Peabody and Atlantic Richfield together hold one-third of all the federally leased coal land in Montana and North Dakota.

23 Federal coal leases, many at bargain rates, are not the only incentives that the Government has provided for the development of Western coal.

23 On Aug. 4, the Interior Department signed an agreement with the gas industry that will add $80-million in Federal funds to $4 0-million from gas and pipeline companies for a four-year acceleration of existing work on small-scale but working pilot coal gasification plants. Some $1 76-million more in Federal money has been set aside for the next step - construction of a full-scale demonstration plant.

23 Meanwhile, the coal industry is working hard to picture the environmental prospect for the West as benign, if not uplifting.

23 Carl E. Bagge, a former member of the Federal Power Commission who now heads the National Coal Association, an influential Washington-based industry group, has been making an unusual number of trips into the West to preview the "new prosperity" in Western coal and to inveigh in speeches against "reckless," "radical," "emotional" conservationist attacks on strip mining.

23 Mr. Bagge has been pointng tot in his Western travels that the strip mining industry genuinely means to do better there than in the ravaged coal fields of the East, and that the tempo of Western nature is slower - there is less timber, less rainfall, less visual discontinuity in stripping buttes and badlands than Appalachian hickory forests or Indiana cornfields.

23 One coal industry suggestion, put forward earlier this year at a session of the Rocky Mountain Mineral Law Institute, was that tourists might have some interest in visiting the scarred and barren "badlands" created by strip mining.

SULFUR CONTENT OF STRIPPABLE COAL RESERVES

Grade n1 Millions of tons by sulfur content

		Low	Medium	High	Total
Wyoming	B	13,377	65	529	13,971
Montana	B, C	6,133	764	0	6,897
New Mexico	B	2,474	0	0	2,474
North Dakota	C	1,678	397	0	2,075
West Virginia	A	1,138	669	311	2,118
Texas	C	625	684	0	1,309
Kentucky (east)	A	532	189	60	781
Colorado	A	476	24	0	500
Arizona	B	387	0	0	387
South Dakota	C	160	0	0	160
Virginia	A	154	99	6	258
Washington	B	135	0	0	135
Alabama	A	33	74	27	134
Arkansas	A, C	28	118	28	174
California	B	25	0	0	25
Oklahoma	A	10	44	57	111
Utah	A	6	136	8	15 0
Tennessee	A	5	43	26	74
Michigan	A	0	0	1	1
Maryland	A	0	8	13	21
Ohio	A	0	126	907	1,033
Iowa	A	0	0	180	180
Kansas	A	0	0	375	375
Pennsylvania	A	0	225	527	752
Kentucky (west)	A	0	0	977	977
Indiana	A	0	293	803	1,096
Missouri	A	0	0	1,160	1,160
Illinois	A	0	80	3,167	3,247
Total		31,787	4,036	9,161	44,986

24 n1 A - Bituminous; B - Subbituminous; C - Lignite.

24 Source: The New York Times, Aug. 22, 1971.

24 Note: The westward movement of stripmining has resulted from low-sulfur reserves west of the Mississippi that promise less pollution in fuels to meet the energy crisis.

24 PRO AND CON IN A BITTER DEBATE

24 WASHINGTON, Aug. 21 - Behind the argument over strip mining there lies a maze of complex public issues and private interests that the combatants on both sides agree touch on the most serious environmental questions in the country

today.

24 On one side is the nation's seemingly infinite demand for electrical energy and, at the same time, for clean air. On the other is its equally urgent desire to preserve the national environment.

24 Coal, the cheapest of fossil fuels, now provides the energy for more than half the country's electric power production. Although it has been a major source of particulate and sulphur-dioxide pollution, the Atomic Energy Commission is now saying that coal will continue to dominate the utility market for three more decades.

24 Thus, as power demands increase, so will coal mining. The cheapest coal - and the safest coal to mine in human terms - is strip mined coal.

24 Much of the vast Western coal reserves can be mined in no other way. It is too shallow for underground tunneling, or in seams that are too thick or structurally unsound.

24 One of the chief attractions of the Western coal is that it is low enough in mineral and chemical contaminants to meet the strictest air pollution standards when it is burned.

24 It is also the only coal abundant enough, in concentrated beds, to supply the new coal gasification industry, another source, when it is fully developed, of nonpolluting fuel.

24 The assault on strip mining has brought a fierce response from the coal and electric utility industries, and even from some Government officials.

24 "Unwilling or unable to face up to the facts of life" is the characterization given the conservationists by Aubrey J. Wagner, the board chairman of the giant, Government-owned Tennessee Valley Authority, the nation's largest single power producer and the largest consumer of strip-mined coal.

{25} In testimony before the Tennessee Legislature last April, Mr. Wagner said that environmentalist critics who seek to abolish strip mining outright or to impose prohibitive reclamation standards "fail to recognize that coal is essential if the electric power needs of the nation are to be met."

25 "Nor do they understand that coal cannot be obtained in the near term without resort to strip mining," he continued, "and, further, that resort to deep-mined coal instead, even in the long term, creates problems of environmental deterioration and human safety. They would outlaw strip mining even in the face of the fact that such action would create a power shortage in which industrial activity would be severely curtailed, unemployment would

increase, commerce would stagnate, and home life would be disrupted."

25 Conservationists call the "trade off" idea - that a measure of strip-mine damage is acceptable to guarantee the nation's power supply - a rationalization in advance for a permanent defacement of the land.

25 Moreover, many conservationists seriously question the industry's assertion that it is averting an electric power crisis by strip mining more and more coal.

25 "We waste electric power as if it were cheap and easy to get," Ed Chaney, a National Wildlife Federation lawyer, said in an interview."But if you look at what strip mining has done to West Virginia or Southern Illinois and Indiana, you see that it wasn't cheap after all."

25 "If we ever see, as a people, what strip mining is doing to our country," Mr. Chaney said, "I'm sure we would insist on some other answer, and less use of electricity may be a temporary solution while we find other means of generating power."

25 [From the Christian Science Monitor, Sept. 23, 1971]

25 STRIP COAL ON WAY IN MONTANA

25 BILLING, MONT. - Montana Power Company has picked the small southeastern Montana community of Colstrip, 100 miles east of Billings and the site of extensive strip mining of coal for many years, to locate a 350,000-kw., coal-fired power-generating station. It is a possible first step in turning the area into the electricpower generation center for the entire northern Rocky Mountain area.

25 Cost of Colstrip Unit No. 1, as the plant is being called, is $6 0 million, exclusive of transmission facilities. George W. O'Connor, president of Montana Power, says preliminary construction began in August, and the plant is scheduled for completion by July 1, 1975. The first of two 230,000-volt transmission lines, which will carry power from the plant site to the company's load and switching center in Billings, is under construction.

25 The plant, which Mr. O'Connor said "can be developed ultimately to produce 3,000,000 or more kws. of power," is the first minemouth generating station to be constructed in Montana and may be the forerunner of a much more extensive development of eastern Montana's vast coal fields.

25 RECENT UPROAR

25 News of the new Montana plant comes on the heels of a recent uproar over

coalfired power plants in New Mexico, Arizona, Utah, and Nevada. The plants there have triggered heavy opposition from environmentalists and caused Secretary of the Interior Rogers C. B. Morton, to clamp a moratorium on new plants on the Colorado Plateau pending a study of their impact on the environment.

25 Eastern Montana coal is prized for power-generating plants in a pollutionconscious nation because of its low sulfur content and because it lies near the surface, readily available for strip mining. Much of it also is in a sparsely settled sagebrush-covered area of plains or low rolling hills, where reclamation of disturbed land is neither difficult nor costly.

25 Numerous coal or power companies are interested in the area.

25 A new coal mine recently was opened near Decker in the southeastern corner of Montana, an area other mines formerly had operated. It will supply 22 million tons of coal over a six-year period to Commonwealth Edison Company of Chicago, beginning early in 1972.

25 Another likely development area is in the vast Sarpy Creek coal field about 80 miles northeast of Billings, where four major coal companies have acquired holdings. Sarpy Creek reportedly has more than 6 billion tons of subbituminous coal with less than 1 percent sulfur content.

{26} Planned developments stirred some opposition in the recent session of the Montana Legislature. Some lawmakers opposed "mine-mouth energy" plants that would use Montana coal to produce electrical energy for transmittal out of state. They would prefer industrial firms to locate plants in Montana to use locally produced power.

26 The Montana power plant at Colstrip will use coal being produced at the site by the company's wholly owned subsidiary, Western Energy Company.

26 But other coal companies also are interested in the area. In February, Peabody Coal Company bid $5 6 per acre to win a 4,306-acre federal coal lease near Colstrip. Edwin Azidlicz, state director of the United States Bureau of Land Management, said "spirited bidding . . . indicates a new era for Montana's valuable coal resource."

26 In April, bids totaled $2 ,348,290 for prospecting permits on the Northern Cheyenne Indian Reservation, south of Colstrip.The propsecting area covers 367,429 acres in 18 tracts. Low bidders for various tracts, with 13 companies submitting bids, included Meadowlark Farms of Indianapolis, Ind.; Consolidation Coal Company of Pittsburgh; Belco Petroleum Corporation and some Montana firms.

26 ACTION CENTER

26 Consolidation Coal Company also is interested in some huge coal fields at Roundup, 50 miles north of Billings, where it plans extensive strip mining in an area that formerly produced coal from underground mines. The community of Roundup welcomes the development, but landowners in the Bull Mountains, a scenic area, oppose the company on ecological grounds. Consolidation, however, claims it can successfully reclaim any strip-mined area satisfactorily, even if not restoring it to its original condition.

26 Westmoreland Resources Group of Colorado has purchased coal prospecting and water rights from the Crow Indian tribe, whose reservation in southeastern Montana also has vast coal deposits.

26 While action has centered within 50 miles or so of the Colstrip area, most of eastern Montana has vast beds of readily accessible coal. Coal production in the area doubled last year, and will increase another 65 to 75 percent by 1973, according to C. R. Binger, vice-president for resource and development of Burlington Northern.

26 The 1971 session of the state Legislature recognized the likely development of eastern Montana coal fields in the near future, and took steps both to obtain revenue from it and to protect the region from the evils of strip mining that have been evident elsewhere.

26 A tax bill signed into law this year has sliding rates of from 4 to 12 cents a ton, depending upon heating content of the coal, and averaging about 10 cents per ton. The state also adopted laws requiring reclamation of strip-mined lands, and new federal strip-mining regulations are being enforced for the first time in the new developments at Colstrip.

26 [From the Sierra Club Bulletin, February 1971]

26 THE STRIPMINING OF AMERICA

26 (By Wayne Davis *)

26 * Mr. Davis is Professor of Zoology at the University of Kentucky, Lexington.

26 Kentucky is being destroyed by stripmining.Not slowly and surely, but rapidly and at an ever accelerating rate. And the disease that affects Kentucky soon may spread to more than half our other states.

26 Most Sierrans are aware of the problem of acid mine drainage.Sulfur impurities in coal, when excavated and exposed to the air, invite invasion by

bacteria which manufacture sulfuric acid. The result is streams with a pH so low that nothing survives but bacteria, the damage is permanent; some sickly red streams run dead a hundred years after mining operations have ceased, with little prospect of improvement in sight.

26 The extent of the problem is enormous. Keith O. Schwab, of the Federal Water Quality Administration in Cincinnati, has data showing 12,000 miles of degraded streams from mine acid drainage in the Appalachian states. "We can ill afford to lose more streams to mining pollution," he said, "but this is exactly what is happening."

26 Acid mine drainage has been with us as long as we have been mining coal. It comes from deep mines and surface mines. It has long been accepted by most local people as a price they must pay for an economy which removes the coal and burns it up as quickly as possible. Progress means removing the wealth, destroying it, and leaving the land and streams permanently impoverished.

{27} Acid mine drainage, considered one of the most vicious of industry by-products, is trivial however compared to the massive onrush of destruction caused by the incredibly rapid move to surface mining.

27 In surface mining heavy machinery removes the soil, including trees, grass and everything else on the surface, to expose the coal seam beneath. In the steep hill country of Eastern Kentucky, this means pushing massive amounts of spoil down the mountainside. Even the largest trees are broken and pushed over. The magnitude of the devastation is difficult to imagine for anyone who has not seen it. Man's ever accelerating technology, now rushing forward faster than the speed of thought, has designed machinery which will move 100 cubic yards of dirt with a single bite. Such shovels, standing as high as a 12 story building, are used around the clock, as is the smaller equipment at many of the mountain stripping sites. With profits running as high as 50 percent annual return on the dollar invested and the minimum price of Eastern Kentucky coal having doubled over a 6 month period last year, the rush is on while the getting is good. Western Sierrans who watched the timber barons' frenzied efforts to cut as many big trees as they could before Congress established a national park will understand the rape of Kentucky. As stripping grows and as people become more informed, the opposition forces encompass an ever larger segment of the public.

27 When rain falls upon a strip mine site massive quantities of mud wash into the streams. A study by the U.S. Forest Service in Kentucky showed streams carried as much as 46,000 ppm of suspended sediment, compared to a maximum of 150 ppm in adjacent forested watersheds. Stream bed burdens of as much as 66,500 cubic feet of sediment per square mile of watershed were observed in the stripped areas. In addition to the stream beds the woodland flood plains were also made a muddy mess from silt. Subsequent rains not only brought down

more silt but moved part of the previous loads on downstream, affecting more of our watercourses.

27 Bethlehem Steel Corporation has mined the high quality low sulfur coal needed for processing steel from deep mines in Eastern Kentucky for many years without arousing the displeasure of conservationists. However, their decision in 1969 to strip 40,000 acres in several counties changed them from an acceptable responsible corporation into the number one target and rallying point for the anti-stripping forces. Stripmining not only puts permanent scars on the mountainsides, but it also kills the streams, which are public property.

27 Silt kills streams by destroying the nature of the bed. Many aquatic invertebrates upon which fish feed live beneath stones in the gravel-covered bottom of a stream. A fine load of silt from the clay-banks above glues down the stones, making them inaccessible and preventing the free movement of oxygen-carrying water among the gravel and beneath the stones.

27 The effect upon spawning of fish is similar. Most species of game fish lay eggs in the gravel of the stream bottom. If a fine layer of silt washes off the strip mine spoils and covers the eggs, they are deprived of sufficient oxygen for development and fail to hatch. Thus the stripminers rob the public of a valued resource.

27 Although land destruction occurs, acid mine drainage and silt are the best known effects of stripmining, a less known but equally dangerous factor may be the raising of the mineral ion concentration of the water effecting its usability by man and his industries. The U.S. Public Health Service sets standards for drinking water quality and the various industries have their own tolerance levels depending upon the purpose of the water they use.

27 The U.S. Forest Service has done studies on the effects of stripmining on water quality in Eastern Kentucky. In a report they point out that although the U.S. Public Health Service's Maximum Permissible Level for sulfates in water is 250 ppm, on severely disturbed watersheds in Eastern Kentucky they found concentrations ranging up to 2100 ppm. Whereas the tolerance level for manganese is 0.05 ppm, concentrations of up to 74 ppm were found, and for iron, whose recommended maximum level is 0.3 ppm, concentrations ranged up to 88 ppm.

27 Why the tremendous increase in stripmining activity? Many reasons have coalesced to result in today's frenzy.

27 The use of electrical power, pushed along by Madison Avenue's request that we live better electrically, have been growing at 7 percent per year, a rate which doubles consumption every 10 years.Coal is a major energy source for power generators.

{28} Even with nuclear reactor power generators increasing at a rate that doubles their numbers every 2.4 years, with this rate expected to continue at least through 1980, the demand for power is increasing so fast that coal powered generators also are being built.

28 The scarcity of natural gas, which caused gas companies in the East to deny service to many new industrial customers in 1970, and the ever increasing dependency of this country on foreign oil sources, has increased the interest in coal, one resource which is still in abundant supply.

28 The new mine safety law has helped push operators out of deep mining into the stripmining business. Stripping produces three times as much coal per man as an underground operation and requires less machinery and investment. It is safer for the workers and more profitable to the operators. The result has been that the strip mine has risen from 29 percent of the production 10 years ago to 36 percent today. In the steep Appalachian hills of 9 states strip mine benches now extend for 20,000 miles. Since only 4.6 billion of the estimated 108 billion tons of strippable coal have been harvested, one can see what the future holds.

28 As the acceleration of stripmining proceeds, attempts to regulate it are frustrated. Although Kentucky has a fairly good mining reclamation law and some honest, conscientious people in the Division of Reclamation, law enforcement has broken down. An employee of the Division told me that during the summer of 1970 permits were issued to over 100 new operators. Since anyone who can borrow enough to get a bulldozer into operation can go into business and get rich now, there is a flood of new people into stripmining. The enforcement officer said that some of these inexperienced operators could not operate within the law even if trying to do so and spills of spoil onto public highways and into the streams are the result.

28 The business is so lucrative that an operator has been quoted as saying that if we will leave him alone for just two years he doesn't care if we outlaw stripmining, for by that time he would be rich enough to retire.

28 Operators are getting rich and selling out to the big corporations. The giants of oil and steel, smelling the killing at hand, have been rushing into the fray like a pack of sharks to a bleeding swimmer. The major stripmining operations are subsidiaries of such corporations as Gulf Oil, Humble Oil, U.S. Steel and Bethlehem Steel. TVA is also heavily involved.

28 If you think coal mining is only a problem for Kentucky and such well known coal states as West Virginia, Pennsylvania and Illinois, you are in for a surprise. A total of 26 states have strippable reserves of coal. We easterners will not even be in the running when the big time arrives, because the states with the largest reserves of strippable coal are North Dakota, Montana and

Wyoming. If we draw a line from Pennsylvania to the coal-laden northwestern tip of Georgia, every state west of the line except Wisconsin, Minnesota and Hawaii has some coal deposits. With the industry's trend toward building power plants where the coal is, the destruction of parts of your state may be even now on the shallow horizon.

28 Stripmining as a big business has moved into Ohio. Ben A. Franklin of the New York Times reports that 5 billion tons of low grade fuel, long considered too marginal for mass mining, lie near the surface in Ohio, and the boom is on from Cincinnati to the east-central border to recover it. In 346,000 acre Belmont County alone 200,000 acres have been sold, leased or optioned to the strippers. Two giant electric shovesl, each 12 stories high, scoop up farms, barns, silos, churches and roads to uncover the coal, piling the rubble into strip mine spoil banks. Franklin quotes Ohio Congressman Wayne Hays, whose home is in Belmont County, as saying "They're turning this beautiful place into a desert," but Ford Sampson, head of the Ohio Coal Association is credited with the line, "Are we going to cut off the electric power because some guy has a sentimental feeling about an acre of coal?"

28 Perhaps a better example of what we are up against is illustrated by the opinion of James D. Riley, a vice president of Consolidation Coal Company, who spoke to the American Mining Congress in Pittsburgh in 1969. To the thunderous applause of the assembled strip miners, Mr. Riley declared that the conservationists who demand a better job of land reclamation are "stupid idiots, socialists and commies who don't know what they are talking about. I think it is our bounden duty to knock them down and subject them to the ridicule they deserve."

28 What can be done? First we must insist that Americans take their heads out of the sand and recognize the fact that power demand cannot continue to rise as it has been. Nothing - whether the power demand, the production of coal, the number of people, the number of cars, or the gross national product - can continue indefinitely to rise at an exponential rate in a finite world. The sooner we face reality on this, the sooner we can begin to attack the problems.

{29} So the next time the power tycoons tell you they must double power capacity by 1980 you should reply, "Nonsense - long before 1980 we must plan and put into practice a program to level off power consumption at something like present levels or less."

29 Second we must have federal regulations of mining practices. Any local efforts to regulate this or any other industry encounter the standard and somewhat justified reply that regulation would put them at a disadvantage with their competitors in other states.

29 Dr. Robert Kuehne says that in Kentucky we could not have designed a

better system to ruin the maximum number of streams in a shorter period. Instead of mining watersheds that are already destroyed until all the coal is gone, the economic system assures that we skip around in such a way as to kill all our streams in the coal country.

29 The Committee on Resources and Man of the National Academy of Sciences-National Research Council has pointed out that the culmination of oil production in this country is now at hand and the culmination of natural gas will arrive at the end of this decade. We are now dependent upon foreign sources for 20 percent of our oil supplies, and by the end of this decade this is expected to rise to 40-45 percent.Although coal reserves are much greater, we should not continue to treat them as the common enemy to be destroyed with all speed by the system found to be so effective in getting rid of our oil and gas.

29 We simply cannot afford to continue the present pattern of exploitation of the fossil fuels.

29 [From Coal Age, March 1971]

SELECTED READINGS

NATURAL RESOURCES AND ENERGY REQUIREMENTS

{45} [From the Minerals Yearbook, vols. I-II, U.S. Department of the Interior, 1969]

45 TECHNOLOGIC TRENDS IN THE MINERAL INDUSTRIES (METALS AND NONMETALS EXCEPT
FUELS)

45 (By John L. Morning n1

45 n1 Physical scientist, Division of Ferrous Metals.

45 A banner year was enjoyed by the mining industry as value of metals and nonmetals reached $8 .96 billion. To accomplish this, nearly 4 billion tons of material was handled, including 2.6 billion tons of crude ore.

45 In the battle for lower unit costs, wheel tractor scrapers have found wider application owing to improved design, which has added versatility and increased production capability of these units. n2

45 n2 Fites, Donald V. Tractor Scrapers Break New Ground. Min.Eng., v. 21, No. 5, May 1969, pp. 69-71.

45 The development of larger size front-end loaders during the past 10 years

has resulted in a change in their use from strictly stockpile loading to competition with electric shovels for primary pit loading applications. n3 Also, during the past 10 years there has been an improvement in the cost performance of off-highway haulage trucks with the increase in truck size from 22- to 40-ton capacity in 1960 to the present-day 85 to 120 tons and larger. n4

45 n3 Haley, W. A. Trends In Front End Loaders. Min.Cong.J., v. 55, No. 5, May 1969, pp. 58-60.

45 n4 Halls, J.L., and R. E. Buckley. Open-pit Mining. Min.Ann.Rev., 1970 ed. (London), June 1970, pp. 149-165.

45 A comparison of various construction and mining earth-moving equipment made by various manufacturers was published. n5 Tractor shovels ranged to 22-ton carrying capacity; self-propelled scrapers to 72 tons; and off-highway haulers to 200-ton maximum carrying capacity.

45 n5 Construction Methods and Equipment. Specs. For Your Files 1969. V. 41, No. 11, November 1969, pp. CM1-CM24.

45 Surveys were conducted by the Engineering and Mining Journal on the use of trucks in the metal and nonmetal mining industries. n6 According to one study, an estimated 8,930 off-highway trucks were in use in the United States in 1968. Over 67 percent of the trucks in use were over 30-ton capacity; 28 percent were over 70-ton capacity. The great majority were equipped with automatic transmissions and power steering. Vehicle availability averaged 82 percent and operating costs averaged $15 5.64 per hour. The survey indicated continued mining industry expansion and forecasts major growth in truck haulage, and increasing use of over 100-ton units.

45 n6 Engineering and Mining Journal. E&MJ Survey of On-Highway Trucks in the U.S. Metal and Nonmetallic Mining Industry. 1969, 19 pp.

45 Engineering and Mining Journal. E&MJ Survey of Off-Highway Trucks in the Metal and Nonmetallic Mining Industry. 1969, 20 pp.

45 According to the second survey, over 30,000 on-highway trucks were in use at domestic metal and nonmetal mines in 1968. More than half of these trucks were pickup or panel types, and over 60 percent had a gross weight of over 10,000 pounds. In contrast to off-highway trucks, comparatively few on-highway trucks were equipped with automatic trnsmissions and power steering. Operating costs averaged $5 .39 per hour. The survey indicated that the use of this type vehicle will grow at the same rate as the mining industry.

45 Big hole drilling continued to hold the interest of miners, contractors, and manufacturers as the Second Symposium on Rapid Excavation was held late in

the year. n7 It was indicated that raise boring as a method for creating mine openings has accounted for 90,000 to 100,000 feet of big hole raises in all parts of the world to date. Canada heads the list of raise drilling machines in operation with 16 and the United States was next with 12. The worldwide total was 51.

45 n7 World Mining. Big Hole Drilling, Progress and Costs. V. 6, No. 1, January 1970, pp. 28-31.

45 The International Nickel Co.Inc., a pioneer in bore hole raising, reported a 40-percent decline in mining costs and a 60-percent increase in mining rate. n8

45 n8 Scott, James J. Underground Mining. Min.Cong.J., v. 56, No. 2, February 1970, pp. 35-41.

{46} Mining minerals from the ocean continued to interest many individuals and concerns. At the First Annual Offshore Technology Conference, sponsored by nine professional technological societies, a prototype underwater mining system suitable for commercial exploitation of sea resources was described. n9

46 n9 Flipse, John E. An Engineering Approach to Ocean Mining. Paper Number OTC 1035, Off-shore Technology Conference, May 18-21, 1969, 16 pp.

46 Surface mines continued to account for 95 percent of total material handled and 94 percent of the crude ore produced. Underground mining was rsponsible for substantial percentage of crude ore production in five States; 19 States reported no underground activity.

46 Lower ratios for crude ore to marketable product were the trend compared with 1968, but were generally higher than those in 1964. Ratios for material handled to marketable product for various mineral commodities were generally slightly higher than in 1968, but large-volume commodities were substantially higher.

46 Exploration and development activities continued to accelerate owing primarily to increased activities at copper, lead, and uranium properties. Stripping operations for copper in Arizona accounted for 35 percent of total material handled by exploration and development activities. Arizona also reported over 500 million tons of material handled. This is the first time that any State reported reaching this milestone.

46 In 1968 the use of ammonium nitrate blasting agents continued to increase, whereas the use of permissible explosives continued to decline. The industrial consumption of explosives in 1968 was 2 percent higher than in 1967, but was lower than the record year of 1966

46 MATERIAL HANDLED

46 Total material handled at metal and nonmetal mines and quarries in the United States, approached 4 billion tons during 1969. The quantity of material handled during the past 10 years has increased at an average annual rate of 3.6 percent. A significant portion of this increase was in waste material handled at surface mines which indicated an increase of 5.9 percent annually; crude ore production increased 2.5 percent.

46 Waste material accounted for one-third of the yearly total of material handled owing primarily to stripping activities in the copper industry. For metal operations, copper mines led in waste and total material handled, and iron mines led in crude ore production. The States of Arizona and Florida continued to be the leaders in material handled as they have been since 1965. The quantity of material handled in Arizona, Nevada, and New Mexico was more than twice as much as the quantity in 1960. Mineral commodities that indicated a significant gain in material handled, compared with 1968, were copper, manganiferous ore, molybdenum, uranium, and sand and gravel. Total material handled decreased for placer gold and dimension stone.

46 Surface mines accounted for 95 percent of total material handled during the year; the same as in 1964. However, the quantity of material handled at surface metal mines increased to 93 percent compared with 90 percent in 1964.

46 MAGNITUDE OF THE MINING INDUSTRY

46 In 1969, the number of mines reporting crude ore production to the Bureau of Mines totaled 1,831. In addition, there were 1,423 clay mines, 4,704 crushed and broken stone operations, and 638 dimension stone mines in operation. The 1969 grand total was 8,596 mines, compared with 8,555 mines in 1968; both years exclude sand and gravel operations. Reporting metal mines decreased by 258 mines, of which 50 percent were uranium operations. Nonmetal reporting mines increased by 43 and were spread over a number of mineral commodities.

46 Three iron mines joined the list of those mines producing over 10 million tons of crude ore, but two phosphate rock mines dropped from this category. The Utah copper mine of Kennecott Copper Corp. was the metal mine leader in both output of ore and of total material handled, whereas the Noralyn mine of International Minerals and Chemicals Co. was the leader of nonmetal mines in both categories.

46 COMPARISON OF PRODUCTION FROM SURFACE AND UNDERGROUND MINES

46 Surface mining accounted for 94 percent of the total crude ore production

and 95 percent of the total material handled. Although the percentages remained the same as in 1968, some minor shifting occurred for the various mineral commodities. Five metal commodities, registered an increase, but four registered a decrease for surface crude ore output. For nonmetal commodities, five indicated an increase, but four decreased in crude ore output.

{47} Crude ore production at surface metal mines was more than five times higher than at underground mines; total material handled at surface mines was 14 times higher than at underground mines. Of the nearly 2.5 million tons of material handled at nonmetal mines, only 82,000 tons were from underground operations.

47 Underground mining accounted for substantial percentage of crude ore handled in five States: Colorado, 43 percent; New Mexico, 40 percent; Missouri, 29 percent; Wyoming, 24 percent; and Kentucky, 23 percent. Nineteen States reported no underground activity.

47 RATIO OF ORE TO MARKETABLE PRODUCT

47 The trend for most mineral commodities for the year was toward lower ratios of ore to marketable product compared with 1968, but ratios were generally higher than for 1964. At surface metal mines the ratios were mixed compared with 1968, with about equal distribution of gains and losses. Of the large-volume commodities, copper registered an increased ratio, and iron ore indicated a reduced ratio. In general, surface nonmetal mines indicated smaller ratios compared with 1968 with only feldspar and vermiculite registering increased ratios.

47 Ratios of material handled to marketable product for various mineral commodities indicated increased ratios for nearly one-half of the listed commodities compared with 1968. Copper continued to have the highest ratio as stripping continued to develop new properties and expand other operations. Compared with 1964, the ratio increased 53 percent for copper, 25 percent for iron, and 35 percent for phosphate rock, and marketable units increased 28 percent, 6 percent, and 47 percent, respectively.

47 Most metal commodities indicated an increase in average value per ton compared with 1968 with only mercury and uranium showing a decrease in value. Of the 27 listed nonmetal commodities, 16 indicated increased values, compared with the previous year. Total average value of metal commodities rose to $6.15 from $5 .61 in 1968. Total average value data for nonmetal commodities are not comparable with previous published data.

47 EXPLORATION AND DEVELOPMENT

47 The upward trend in exploration and development accelerated in 1969 and

totaled 31.7 million feet, compared with 25 million feet in 1968.The data, however, is not comparable because clay and stone mines were not included in the 1969 total. Exploration and development work for clay and stone mines totaled 1.5 million feet in 1966, 1.6 million feet in 1967, and 1.2 million feet in 1968. For metals, a significant increased activity was noted for copper, iron, and uranium mines.Rotary drilling accounted for most of the gain at copper and uranium mines, whereas percussion drilling was largely responsible for the increase at iron mines.

47 Arizona, Colorado, Idaho, New Mexico, Texas, Utah, and Wyoming accounted for 86 percent of total footage of exploration and development and were also the only States reporting over 1 million feet. This compares with 1968 when five States reported over 1 million feet each. Rotary drilling accounted for 76 percent of the total activity, and all categories, except trenching and diamond drilling, registered increased footage.

47 Stripping operations for copper in Arizona accounted for 35 percent of total material produced by exploration and development activities. The total tonnage produced increased 28 percent compared with 1968.

47 Increased mining activity in Arizonal resulted in the total material handled exceeding 500 million tons of for the first time. Montana and Wyoming joined the list of States reporting over 100 million tons; New York and Pennsylvania dropped from the list.

47 EXPLOSIVES

47 Explosive statistics for the year of review are released too late for incorporation in this chapter. For 1968, 1,948 million pounds of industrial explosives were reported consumed in the United States. This total was 2 percent higher compared with 1967, but was slightly lower than the record high of 1,970 million pounds in 1966. The coal mining industry used 35 percent of the total, metal mines used 21 percent, and quarrying and nonmetal mines, 20 percent. This is in contrast to 1963, when coal mining accounted for 35 percent, metal mining, 17 percent, and quarrying and nonmetal mining, 22 percent of the industrial consumption.

{48} The use of ammonium nitrate blasting agents continued to increase, whereas the use of permissible explosives continued to decline. There was no reported use of liquid oxygen explosives during 1968.

48 The five top ranking States in order of total quantity of explosives and blasting agents consumed were as follows: Pennsylvania, Kentucky, Ohio, Arizona, and Illinois. This was in contrast to 1963 when the ranking order was Pennsylvania, Ohio, Kentucky, Illinois, and Minnesota. In 1968, the explosive consumption of the ranking States totaled 751 million pounds, or 39 percent of

industrial explosives and blasting agents used in the United States. In 1963 the ranking States used 545 million pounds or 37 percent of all industrial explosives consumed.

48 More detailed explosive information is published by the Bureau of Mines in the Annual Explosive issue of Mineral Industry Surveys prepared by Andris Viksne.

TABLE 1. -MATERIAL HANDLED AT SURFACE AND UNDERGROUND MINES, BY COMMODITIES, IN 1969

[In thousand short tons]

Commodity	Surface			Underground			All mines		
	Crude ore	Waste	Total	Crude ore	Waste	Total	Crude ore	Waste	Total
Metals:									
	n1	n1	n1						
Bauxite	2,501	3,437	5,938	n(2)	n(2)	n(2)	2,501	3,437	5,938
Beryllium	176	507	683	2		2	178	507	685
Copper	198,439	621,726	820,165	27,486	452	27,938	225,925	622,178	848,103
Gold:									
Lode	1,614	8,980	10,594	2,104	355	2,459	3,718	9,335	13,053
Placer	2,195	772	2,967		1	1	2,195	773	2,968
Iron ore	213,997	168,593	382,590	14,877	2,413	17,290	228,874	171,006	399,880
Lead	6	32	38	9,507	749	10,256	9,513	781	10,294
Mangani ferous ore	1,009	2,832	3,841				1,009	2,832	3,841
Mercury	278	535	813	204	19	223	482	554	1,036
Molybdenum	5,339	36,579	41,918	15,861	156	16,017	21,200	36,735	57,935
Nickel	1,184	362	1,546				1,184	362	1,546
Silver	128	75	203	653	298	951	781	373	1,154
Titanium: Ilmenite	22,204	3,529	25,733				22,204	3,529	25,733
Tungsten	26	3	29	442	20	462	468	23	491
Uranium	1,823	89,307	91,130	3,497	1,306	4,803	5,320	90,613	95,933
Zinc	571	1,419	1,890	10,032	7,926	17,958	10,603	9,245	19,848
Other n3	4,082	2,328	6,410	12		12	4,094	2,328	6,422
Total metals	455,000	941,000	1,396,000	85,000	13,000	98,000	540,000	954,000	1,494,000

See footnotes at end of table, p. 50.

Commodity	Surface			Underground			All mines		
	Crude ore	Waste	Total	Crude ore	Waste	Total	Crude ore	Waste	Total
Nonmetals:									
Abrasives n4	396	141	537	48		48	444	141	585
Asbestos	2,178	1,363	3,541	22	3	25	2,200	1,366	3,566
Barite	6,038	3,157	9,195	115	17	132	6,153	3,174	9,327
Boron minerals	12,461	12,010	24,471				12,461	12,010	24,471
	n5								
Clays	57,524	50,000	107,524	1,063	n5 16	1,079	58,587	50,016	108,603

Diatomite 1,042 7,701 8,743 268 268 1,310 7,701 9,011
Feldspar 1,698 389 2,087 9 9 1,707 38 9 2,096
Fluorspar 62 40 102 470 1 471 532 41 573
Gypsum 7,691 11,968 19,659 2,328 73 2,401 10,019 12,041 22,060
Mica 661 463 1,124 661 463 1,124
Perlite 612 1 613 612 1 613
Phosphate rock 126,056 278,411 404,467 671 20 691 126,727 278,431 405,159
Potassium salts 16,989 819 17,808 16,989 819 17,808
Pumice 3,952 136 4,088 3,952 136 4,088
Salt 5,400 3 5,403 14,371 636 15,007 19,771 639 20,410
Sand and gravel 936,906 936,906 936,906 936,906
Sodium carbonate (natural) 4,072 124 4,196 4,072 124 4,196
Stone: Crushed and broken 822,077 n5 68 822,145 38,935 n5 270 39,205 861,012 338 861,350
Dimension 4,000 n5 900 4,900 29 29 4,029 900 4,929
Sulfur: Frasch-process mines 8,003 8,003 8,003 8,003
Other mines 2 2 2 2
Talc, soapstone, and pyrophy llite 553 1,235 1,788 519 14 533 1,072 1,249 2,321
Vermiculite 1,505 4,150 5,655 1,505 4,150 5,655
Othern5 1,946 2,836 4,782 85 85 2,031 2,836 4,867
Total nonmeta 2,001,0 2,376,0 2,081,0 2,458,0
ls 00 375,000 00 80,000 2,000 82,000 00 377,000 00
Grand 2,456,0 1,316,0 3,772,0 2,621,0 1,331,0 3,952,0
total 00 00 00 165,000 15,000 180,000 00 00 00
[See Table in Original]

49 n1 Includes underground; Bureau of Mines not at liberty to publish separately.

49 n2 Withheld to avoid disclosing individual company confidential data.

49 n3 Magnesium, manganese, platinum-group metals, rare-earth metals, and vanadium.

49 n4 Emery, garnet, and tripoli.

49 n5 Estimated.

49 n6 Aplite, graphite, greensand marl, kyanite, lithium minerals, magnesite, olivine, pyrites, and wollastonite.

TABLE 2. - MATERIAL HANDLED AT SURFACE AND UNDERGR OUND MINES (INCLUDING SAND GRAVEL AND STONE),
BY STATES, IN 1969 n1

[In thousand short tons]

State	Surface			Underground			All mines		
	Crude ore	Waste	Total	Crude ore	Waste	Total	Crude ore	Waste	Total
Alabama	32,257	18,251	50,508	1,974	248	2,222	34,231	18,499	52,730
Alaska	22,627	1,475	24,102				22,627	1,475	24,102
Arizona	135,273	353,935	489,208	16,639	384	17,023	151,912	354,319	506,231
Arkansas	32,465	4,574	37,039	946	17	963	33,411	4,591	38,002
California	195,658	56,729	252,389	2,103	36	2,139	197,761	56,765	254,526
Colorado	23,523	125	23,648	17,777	1,323	19,100	41,300	1,448	42,748
Connecticut	16,817	42	16,89				16,817	42	16,859
Florida	183,565	245,043	428,608				183,565	245,043	428,608
Georgia	40,531	61	40,592	995		995	41,526	61	41,587
Idaho	16,385	12,795	29,180	1,755	323	2,078	18,140	13,118	31,258
Illinois	99,102	1	99,103	2,429		2,429	101,531	1	101,532
Indiana	53,047		53,047	905	34	939	53,952	34	53,986
Iowa	45,722	6,218	51,940	1,306		1,306	47,028	6,218	53,246
Kansas	27,804	195	27,999	2,671	6,000	8,671	30,475	6,195	36,670
Kentucky	32,683	12	32,695	7,350	1	7,351	40,033	13	40,046
Louisiana	33,045		33,045	5,914		5,914	38,959		38,959
Maine	12,642	1,187	13,829	6		6	12,648	1,187	13,835
Maryland	30,409	16	30,425	57		57	30,466	16	30,482
Massachusetts	27,635		27,635				27,635		27,635
Michigan	130,789	14,104	144,893	14,090	379	14,469	44,879	14,483	159,362
Minnesota	206,133	91,412	297,545				206,133	91,412	297,545
Mississippi	13,909		13,909				13,909		13,909
Missouri	51,300	2,348	53,648	21,277	462	21,739	72,577	2,810	75,387
Montana	41,566	59,071	100,637	868	15	883	42,434	59,086	101,520
Nebraska	17,540		17,540	33		33	17,573		17,573
Nevada	33,265	61,223	94,488	353	108	461	33,618	61,331	94,949
New Hampshire	6,683		6,683				6,683		6,683
New Jersey	37,428	286	37,714	150	1	151	37,578	287	37,865
New Mexico	28,819	117,087	145,906	18,790	1,241	20,031	47,609	118,328	165,937
New York	86,225	5,148	91,373	5,938	214	6,152	92,163	5,362	97,525
North Carolina	46,866	16,817	63,683	52	10	62	46,918	16,827	63,745
North Dakota	7,174		7,174				7,174		7,174
Ohio	103,886		103,886	5,654	400	6,054	109,540	400	109,940
Oklahoma	24,950	5,525	30,475	1,178		1,178	26,128	5,525	31,653
Oregon	29,811	472	30,283	1	1	2	29,812	473	30,285
Pennsylvania	84,682		84,682	7,207	1,836	9,043	91,889	1,836	93,725
Rhode Island	2,900		2,900				2,900		2,900
South Carolina	17,713	869	18,582				17,713	869	18,582
South Dakota	13,501	1,606	15,107	1,924	179	2,103	15,425	1,785	17,210
Tennessee	43,074	4,870	47,944	9,970	766	10,736	53,044	5,636	58,680

Texas	90,787	5,066	95,853	460	9	469	91,247	5,075	96,322
Utah	68,434	89,554	157,988	2,687	398	3,085	71,121	89,952	161,073
Vermont	6,563	48	6,611	215		215	6,778	48	6,826
Virginia	46,024	168	46,192	2,811	708	3,519	48,835	876	49,711
Washington	50,737	787	51,524	284	116	400	51,021	903	51,924
West Virginia	13,478		13,478	1,918		1,918	15,396		15,396
Wisconsin	62,298	1,943	64,241	858	48	906	63,156	1,991	65,147
Wyoming	16,480	85,831	102,311	5,285	143	5,428	21,765	85,974	107,739
Other States n2	9,796	30	9,826				9,796	30	9,826
Total	2,454,000	1,265,000	3,719,000	165,000	15,000	180,000	2,619,000	1,280,000	3,899,000

[See Table in Original]

51 n1 Partially estimated data in table 1 not included in State totals.

51 n2 Delaware and Hawaii.

TABLE 3. - VALUE OF PRINCIPAL MINERAL PRODUCTS AND BYPRODUCTS OF SURFACE AND UNDERGROUND ORES MINED IN THE UNITED STATES IN 1969

[Value per ton]

Ore	Surface			Underground			All mines		
	Principal mineral product	Byproducts	Total	Principal mineral product	Byproducts	Total	Principal mineral product	Byrpoducts	Total
Metals:									
Bauxite	$10.40		$10.40	n(2)	n(2)	n(2)	$10.40		$10.40
Beryllium	9.26	$0.05	9.31				9.42	$0.05	9.47
Copper	6.02	.42	6.44	$9.14	$0.94	$10.08	6.40	.49	6.89
Gold:									
Lode	10.92	.02	10.94	13.69	2.74	16.43	12.54	1.61	14.15
Placer	.47		.47				.47		.47
Iron ore	3.79		3.79	7.45	.27	7.72	4.04	.02	4.06
Lead	40.00	19.00	59.00	13.69	5.58	19.27	13.70	5.59	9.29
Mercury	19.50		19.50	43.00		43.00	29.30		29.30
Molybdenum	4.43		4.43	6.64	.29	6.93	6.16	.23	6.39
Platinum-group metals	.54		.54				.54		.54
Silver	5.48	2.64	8.12	39.95	8.13	48.08	34.57	7.28	41.85
Titanium:									
Ilmenite	.84	.27	1.11				.84	.27	1.11
Tungsten	13.92		13.92	46.57	4.17	50.74	44.69	3.93	48. 62
Uranium	27.22	.01	27.23	21.53	.03	21.56	23.97	.02	23.99
Zinc	12.67	4.41	17.08	11.92	2.93	14.85	11.96	3.01	14.97
Average value n3	4.89	.20	5.09	10.33	1.53	11.86	5.73	.42	6.15
Nonmetals:									

Asbestos $4.61 $4.61 $24.81 $24.81 $4.81 $ 4.81
Barite 2.28 2.28 16.10 16.10 2.53 2.53
Clays 4.43 4.43 8.13 8.13 4.49 4.49
Diatomite 41.54 41.54 9.32 9.32 33.59 33.59
Emery 19.85 19.85 19.85 19.85
Feldspar 4.90 $0.22 5.12 4.66 4.66 4.90 $0.22 5.12
Fluorspar 22.51 .01 22.52 14.41 $3.80 18.21 15.33 3.37 18.70
Garnet 25.09 25.09 25.09 25.09
Graphite 328.33 328.33 328.33 328.33
Gypsum 3.52 3.52 4.81 4.81 3.82 3.82
Kyanite 11.82 .24 12.06 11.82 .24 12.06
Lithium minerals 5.81 .76 6.57 5.81 .76 6.57
Magnesite 2.75 .12 2.87 2.75 .12 2.87
Mica:
Flake 3.69 .01 3.70 3.69 .01 3.70
Olivine 16.73 16.73 16.73 16.73
Perlite 8.24 8.24 8.24 8.24
Phosphate rock 1.60 1.60 11.70 11.70 1.62 1.62
Potassium salts 4.00 4.00 4.00 4.00
Pumice 1.35 1.36 1.35 1.35
Salt 16.73 .75 17.12 6.39 .67 7.06 9.39 .69 10.08
Sand and gravel 1.14 1.14 1.14 1.14
Stone:
Crushed and broken 1.52 1.52 1.63 1.63 1.52 1.52
Dimension 51.06 51.06 156.51 156.51 52.69 52.69
Sulfur:
Frasch 24.09 24.09 24.09 24.09
Talc, soapstone, and pyrophyllite 6.32 6.32 7.92 7.92 7.10
7.10
Tripoli 14.13 14.13 4.10 4.10 8.53 8.53
Vermicultie 4.49 4.49 4.49 4.49
Average valuen3 1.69 .01 1.70 3.87 .13 4.00 1.77 .02 1.79
Averagevalue - metal and nonmetals n3 2.28 .05 2.33 7.16 .85 8.01 2.59
.10 2.69
Average value - nonmetals (excluding stone, sand, and gravel)n2 3.97 .12 4.09
5.77 .26 6.03 4.24 .14 4.38
Average value - metals and nonmetals (excluding stone, and gravel)n3 4.57 .18
4.75 8.83 1.12 9.95 5.23 .32 5.55
[See Table in Original]

53 n1 Includes underground; Bureau of Mines not at liberty to publish separately.

53 n2 Withheld to avoid disclosing individual company confidential data.

53 n3 Including unpublished data.

SELECTED READINGS

ENVIRONMENTAL EFFECTS

{91} [From Surface Mining and Our Environment, U.S. Department of the Interior, 1967]

91 Basic Disturbances

91 Surface, mining affects the environment in three ways.To some degree, it influences the quality of our air, land, and water; and, through these, animal and plant life.

91 Air. - Although air pollution is one of our more serious environmental problems, surface mining, per se, cannot be considered a major contributor. However, the dust and vibrations resulting from blasting and movement of equipment during mining operations can be annoying and, in densely populated areas, a public nuisance. Some abandoned surface mines and waste piles also may be a source of air-borne dust.

91 Land. - Two factors that are essential to the establishment of vegetation on surface-mined areas are the physical and chemical characteristics of the spil. The spoil material was considered suitable for agricultural use at only 25 percent of the sites observed during the random-sampling survey. Where excessive stoniness exists (at about 20 percent of the sites inspected) the possiblility of getting a quick, vigorous cover is hampered by the rapid run-off and lack of soil.Most of the remaining 55 percent might be receptive to tree or herbaceous type plantings if climatological conditions are favorable.

91 There were no serious erosion problems at about 60 percent of the areas examined primarily because some vegetation had been established and the slope of the land was relatively gentle before and after mining. Most of the remaining sites showed evidence of erosion in the form of gullies less than one-foot deep; but, at 10 percent of the sites gullies were found that exceeded this depth. Sediment deposits were found in 56 percent of the ponds and 52 percent of the streams on or adjacent to the sample sites.

91 Spoil bank materials which have a pH of 4.0 or less are lethal to most plants. A pH of 7.0 is neutral; values higher than 7.0 indicate alkalinity. Free acid may be leached enough in 3 to 5 years to permit planting, but the leaching process will not improve soil conditions if erosion is allowed to expose more sulfuritic minerals in the spoil. Although some plants achieve successful growth in spoil with a pH range under 5.0, most plants require a less acid environment for successful growth. Of the measurements taken on spoil banks, 1 percent showed a pH of less than 3.0 and 47 percent, a range between pH

3.0 and 5.0.

91 About 15 percent of the spoil banks are covered with vegetation sufficient to provide adequate site protection. Another 15 percent have fair to good cover which, with more time and some spot planting, should suffice to protect the areas and speed renewal of the soil.Twenty percent will require direct seeding, seedlings, and fertilization. About 30 percent of the sites inspected had little, or no, cover and will, therefore, require extensive treatment. On the remaining 20 percent of the sites examined, vegetation will be extremely difficult to grow because of excessive stoniness or toxic conditions. It was also observed that wide variations occur in the rate at which natural revegetation takes place because of differences in physical and chemical characteristics of the spoil, and proximity to seed sources.

91 It was assumed for the random-sampling survey that, generally, mined land had been used prior to mining for purposes similar to those on adjoining tracts, and that, if left untreated by man, the mining site would eventually regain the same types of cover. Field observations made during the survey showed this to be largely untrue, however, because only about one-half of the areas assumed to have been forested had returned to forest and land classified as idle had increased almost fourfold. Land which had been devoted to crops and human occupancy, of course, had not voluntarily returned to these uses. Curiously, most land assumed to have been grassland had returned to grass. Clearly then, in most cases, natural forces will need a strong assist from man if mined sites are to be brought back to their former uses.

91 When natural vegetation is removed by exploration and mining activities, the area becomes virtually useless for wildlife because it becomes barren of food, nesting, and escape cover. Even in the most arid areas of the country, erosion eventually follows removal of vegetation, and the resulting silt and sediment may affect fish and wildlife habitat. Thus, except in a few limited areas of the Midwest, poorer soils and vegetative cover resulting from surface mining create less favorable wildlife habitat. However, mining create less favorable wildlife habitat. However, the rough broken ground found at many sites does afford protection from hunters for some species.

91 Water. - Although basic to human existence, water is perhaps America's most abused resource. The surface mining industries are not the major contributor to the degradation of our water supplies on a national basis, yet in many areas such as Appalachia, they are a significant source of pollution.

91 Chemical pollution of water by surface mines takes many forms. The polluted water may be too acid, too alkaline, or contain excessive concentrations of dissolved substances such as iron, manganese, and copper. High concentrations of dissolved minerals may make the water unsuitable for certain purposes, but not for [*] [*] [*] in it.

91 Sulfur-bearing minerals are commonly associated with coal, and are a major cause of water pollution. When exposed to air and water, they oxidize to form sulfuric acid. This acid may enter streams in two ways: (1) Soluble acid salts formed on the exposed spoil surfaces enter into solution during periods of surface run-off, and (2) ground water, while moving to nearby streams, may be altered chemically as it percolates through spoil, or waste dumps.

{92} Acid drainage is but one of several adverse chemical effects caused by surface mining. Even in minute concentrations, salts of metals such as zinc, lead, arsenic, copper, and aluminum are toxic to fish, wildlife, plants, and aquatic insects. Indirectly associated with acid drainage are the undesirable slimy red or yellow iron precipitates ("yellow boy") in streams that drain sulfide-bearing coal or metal deposits. Of the streams receiving direct run-off from surface mine sites, 31 percent of those examined contained noticeable quantities of precipitates. Water discoloration was recorded at 37 percent of the streams adjacent to the sites observed, suggesting chemical or physical pollution. The discoloration occurred most frequently in connection with the mining of coal, clay, sand and gravel, peat, iron, stone, and phosphate rock.

92 Streams are also polluted by acid water from underground mines, preparation plants, and natural seepage from unworked coal and other pyritic material. Because of the intermingling of effluents from these sources, it is difficult, if not impossible, to determine the quantity of acid that comes from surface mining alone.Many authorities believe, however, that not more than 25 percent of the acid load created by coal mining can be attributed directly to surface operations. Many streams in the Appalachian region are affected to various degrees by acid drainage from both surface and underground mines. Although acid conditions are associated with coal mining conducted elsewhere, the problems are not usually so severe because the topography is not as rugged, rainfall is less profuse, pyritic materials oxidize more slowly, and, in some cases, limestone formations act as a neutralizing agent. Where acidity is neutralized by alkaline water, or limestone, the concentration of certain dissolved substances still may remain high and the water may not be usable without treatment.

92 Acid mine drainage affects fish and wildlife in several ways. Acid changes the water quality of streams into which it is discharged and, although the concentration may not be lethal to fish or wildlife, it may bring about changes in their physical condition and rate of growth. However, acid may be present in such concentration as to be directly lethal to fish or tend to suppress or prevent reproduction of the most desirable species.

92 The Bureau of Sport Fisheries and Wildlife reported that in the United States some 5,800 miles of streams (about 57,000 acres) and 29,000 surface acres of impoundments and reservoirs, are seriously affected by surface coal mining

operations. The Bureau reported that, in 1964, 97 percent of the acid mine pollution in streams and 93 percent in impoundments, resulted from coal mining operations. Similar data were obtained by a United States Geological Survey reconnaissance conducted in 1965, which disclosed that water quality at 194 of 318 sampling sites in Appalachia was measurably influenced by acid mine drainage. None of these data, however, reflect the percentage of damage that can be attributed to surface mining alone.

92 Access roads built of pyritic waste material may also be sources of acid water.In past years, some highway departments have hauled waste from the mines for road building purposes. This practice is not generally followed today, and is forbidden in some States; however, roads built of this material continue to acidify rainwater passing over them - despite long periods of leaching. In addition, some privately constructed mine-access roads are being built of pyritic material.

92 Roads opened on National Wildlife Refuges by prospectors frequently result in broken levees; interfere with controlled burning; increase human activity, which interferes with the nesting and breeding of birds and animals; and, restrict animal movements. The distance that each species, or even individual animals, will place between themselves and the disturbance varies greatly, but some species will leave an area entirely when their natural habitat is invaded by people and equipment.

92 Physical pollution is most serious in areas typified by high-intensity storms and steep slopes, particularly during and shortly after mining. In areas undisturbed by strip mining within the Appalachian region, the average annual sediment yield ranges from about 20 to 3,000 tons per square mile of watershed, depending upon land use. Research conducted in Kentucky indicated that yields from coal strip-mined lands can be as much as 1,000 times that of undisturbed forest. During a four-year period, the annual average from Kentucky spoil banks was 27,000 tons per square mile while it was estimated at only 25 tons per square mile from forested areas.

92 Erosion and sedimentation problems from surface mining are less severe in arid regions; however, even in such areas, storms do occur during which large quantities of sediment are discharged from mine workings, spoil heaps, and access roads. At some idle surface mines in arid country, the effects of wind and water erosion are still evident on steep spoil banks that were abandoned many years ago.

92 One of the major causes of sedimentation problems is the failure to control surface run-off following rainstorms. In areas outside Appalachia, 86 percent of the surface-mined areas investigated were found to have adequate run-off control. Areas lacking sufficient control were confined almost exclusively to the surface mining of coal, phosphate, manganese, clay, and gold.

92 Some 7,000 miles of stream channels have had their normal storm-carrying capacity reduced according to the Bureau of Sport Fisheries and Wildlife. It was observed that the normal water-carrying capacity of about 4,500 miles of these streams had been moderately to severely affected.The remaining 2,500 miles had been affected only slightly (debris reducing channel by less than one-third of capacity). Sediment generally was not a significant problem on small streams located more than two miles from the sample site.

{93} Substandard access and haulage roads, and others built in connection with prospecting activities, are a major source of sediment. Based on the sample data, 95 percent of these roads were less than 3 miles long, but the proximity of many to natural stream channels had considerably increased their potential for sedimentation damage. The roads were fairly passable in the majority of cases; however, approximately 15 percent were eroded to a point that would make them difficult to traverse by ordinary vehicles.

93 Beneficial Effects of Surface Mining

93 When massive rocks are fragmented during surface mining, the resulting piles of material contain considerably more void space than existed in the fractures, partings, and pore spaces of the undisturbed rock. As a result, certain desirable hydrologic effects may occur. The danger of floods is diminished because a significant portion of the rainfall is trapped in depressions and behind the spoil banks where it sinks into the earth to augment ground-water supplies, rather than running off rapidly to nearby streams. Because water stored in the banks moves slowly, drainage will continue for a long time before the water level declines to that of adjacent streams. Thus, streams near surface-mined areas often maintain a longer sustained flow during dry weather than those draining undisturbed ground. This phenomenon was verified through field studies conducted in the Midwest by the Indiana University Water Research Center, but it occurs less frequently in most of Appalachia because of the rapid run-off.

93 In the Western United States, some surface mines have exposed ground-water sources and made water available where none existed before. This water has proved invaluable to livestock and wildlife. At some surface mining operations along mountainsides, the pits impound surface run-off from torrential rains, minimize the sediment load of streams draining the area, and effect considerable ground water recharge as well.

93 In California, piles of dredge tailings are quite permeable. However, because of their irregular conformation, they undoubtedly inhibit surface run-off to a greater degree than the original slopes, thus making some contribution to flood control and ground-water recharge. In Alaska, dredge mining for gold has destroyed the permafrost and the resulting tailings and

mined areas are considered premium property for residential and industrial development.

93 Many mine-access roads, when properly repaired and maintained, can be of considerable value since they may be used to promote the multiple-land-use potential of extensive areas. Accessibility for fire protection, recreation, and management activities, can mean the difference between use and isolation. For example, by improving fire protection, investments can be made more safely in growing timber, and hazards to human and wildlife considerably reduced. Where massive equipment was used in the mining process, the access roads were usually well constructed, and the cost of repairing and maintaining them would be low. By converting some of these roads to public use, tourism might also be encouraged because many of the sites examined (33 percent) were located in areas that afforded spectacular views of mountains, valleys, and lakes.

93 Surface mining has created many opportunities to develop recreational areas where none existed before. Water in the form of small ponds or lakes, and the spoil piles themselves, frequently provide a pleasant topographic change in areas of virtually flat land. Examples may be found in flat coastal areas and in such States as Kansas, Illinois, Indiana, Ohio, and California.

{94} [From the Mineral Industry and the Environment]

94 POLLUTION OF THE LANDSCAPE

94 (By Samuel M. Brock, West Virginia University, Morgantown, W.Va., June 1970)

94 Considerable progress has been made in air and water pollution, both in terms of regulation through legislation and development of technology for pollution abatement. By contrast, pollution of the landscape through activities such as surface mining and disposal of solid wastes continues to present many unsolved problems. Indeed, progress in air and water pollution control has contributed to the complexity of these problems. Removal of particulates and other impurities in air, for example, creates additional solid waste for disposal.

94 Past trends in land use indicate that there often has been a lack of concern in extracting minerals and other natural resources from land resources. Mineral deposits which were most accessible, and which promised the greatest profit to the producer, were mined with little concern for associated destruction of the land. Social costs, including creation of millions of acres of derelict land through surface mining, were largely ignored. In recent years, however, such practices have been subjected increasingly to public criticism. This has led to more stringent regulation of the mineral industry. Surface mining, in particular, has been more rigorously controlled.

94 Simply stated, surface mining consists of removing the topsoil, rock, and other strata that lie above mineral or fuel deposits to recover them. n36 In the process protective vegetative cover is destroyed, and overburden often is cast in massive piles onto land adjacent to the mine site. The mining results in a considerable alteration of the land surface, and changes sub-surface drainage patterns as well. Acres upon acres of land may be disturbed to depths sometimes exceeding 100 feet. Such disturbances have led to massive landslides which have blocked rivers and highways. They also have contributed to water pollution by acid mine drainage and sediment.In addition, land areas have been isolated by mile after mile of contour benches, and aesthetic and other economic values have been seriously impaired. 94 n36 For a general description of surface mining and its effects on the environment, see U.S. Department of the Interior, op.cit. note 15.Also see D.B. Brooks, "Strip Mine Reclamation and Economic Analysis," Natural Resources Journal, Vol. 6 (1966), pp. 13-44.

94 Disturbances created by surface mining are evident in almost every state. However, probably nowhere are the results of mining more spectacular than in the mountainous Appalachian region. There, the contour strip mining of coal has produced about 20,000 miles of cliff-like highwalls. n37

94 n37 U.S. Department of the Interior, op.cit. note 27 at p. 22.

94 It has been estimated that prior to 1965, 3.2 million acres of land had been disturbed by surface mining in the United States. n38 This area includes only the excavation, or pit, and land upon which waste or spoil from mining was deposited. About 320,000 additional acres have been disturbed through the construction of access roads and by exploration. An estimated 95 percent of the acreage disturbed by surface mining can be attributed to seven commodities; coal, sand and gravel, stone, gold, clay, phosphate, and iron. All other commodities combined account for only 5 percent of the acreage.

94 n38 U.S. Department of the Interior, op.cit. note 15 at p. 39.

94 The economic productivity of surface mining is subject to considerable debate. Economic returns are probably quite variable, depending upon such factors as the terrain, depth of the mineral or fuel deposit and its thickness, and possibilities for returning the land resources to productive uses following mining. n39 Undoubtedly, there are cases where the social costs incurred in mining coal and other commodities exceed the social benefits. In such cases, surface mining is wasteful of resources, and according to economic criteria, should be prohibited. However, even if surface mining is economically productive, society may be willing to bear the cost of prohibiting it in order to preserve the environment. Thus, the issue of whether or not to permit surface mining raises some difficult social, economic, and legal questions. Limited research has been undertaken to provide answers. Cost and benefit data

for mining operations under varying conditions, for example, are not available, and are not easily obtainable. n40 Nor has the legality of prohibiting surface mining even if it is clearly economically indefensible been resolved. These problems will require considerable research effort and social action, including litigation, to provide satisfactory solutions.

94 n39 See, for example, S. M. Brock and D. B. Brooks, The Myles Job Mine - A study of Benefits and Costs of Surface Mining for Coal in Northern West Virginia. Research Series No. 1 (Morgantown: West Virginia University, Office of Research and Development, 1968).

94 n40 S. M. Brock, "Benefit-Cost Analysis of Surface Coal Mining," Mining Engineering, Vol. 21 (1969), pp. 75-77.

{95} In contrast to pollution of air and water resources, which is regulated under various federal laws, there is no federal legislation regulating surface mining. Thus, no national program of mined-land conservation exists. Twenty of the 50 states now directly regulate surface mining. Regulation of mining under these laws often has not been consistent because of conflicting opinions concerning land use.

95 West Virginia was the first state to enact surface mining legislation. It passed its first law in 1939. Indiana enacted a similar statute in 1941, followed by Illinois, 1943; Pennsylvania, 1945; Ohio, 1947; Kentucky, 1954; Maryland, 1955; Virginia, 1966; and Tennessee, 1967. Since 1967, Kansas, Maine, Oklahoma, Alabama, Iowa, Wyoming, Colorado, Montana, Minnesota, North Dakota, and Georgia have enacted laws. All of these laws cover the surface mining of coal. n41 Only six states, however, regulate the surface mining of all commodities.

95 n41 A brief summary of the provisions of laws enacted prior to 1967 is given by U.S. Department of the Interior, op.cit. note 15 at pp. 118-20. Also see G. S. Bergoffen, op.cit. note 26 at pp. 32-61. The laws of individual states are generally reviewed in detail in law journals shortly after passage or amendment.

95 Land usually may be returned to productive uses following mining by the reclamation required by the state laws. Reclamation consists of backfilling, regrading, and revegetation the mined area. Regrading and revegetation tend to reduce or eliminate mine drainage problems and stabilize the soil, thus reducing erosion. Oftentimes, agricultural crops or commercial timber products may be produced on reclaimed land. Sometimes attarctive recreational areas may be created. However, restoration of natural scenic values often may be difficult or impossible, depending upon the type of mining and topography. Elimination of scars caused by highwalls may prove economically infeasible. n42

95 n42 S. M. Brock and D. B. Brooks, op.cit. note 39.

95 Problems of reclaiming mined areas have not been adequately solved. n43 Finding less costly methods for successfully returning mined areas to productive uses presents an urgent research need. There also are technological and engineering problems that require solution. Previous research has provided only partial answers for such problems as eliminating acid and sediment pollution, and developing techniques to form and stabilize the soil. The identification of plant species that will thrive on mined areas is another research need.

95 n43 See, for example. W. C. Lorenz, op.cit. note 20 and G. S. Bergoffen, op.cit. note 26.

95 The success and extent of previous reclamation efforts can be ascertained by comparing the acreage disturbed by surface mining with the total reclaimed. Of the 3.2 million acres that have been disturbed since surface mining began in the United States, about one-third has been judged by the Soil Conservation Service as needing no further treatment. n44 This means that about 2 million acres require further reclamation work.

95 n44 U.S. Department of the Interior, op.cit. note 15 at p. 14.

95 Most of the reclamation that has been accomplished has been on coal lands. Only a very small acreage has been reclaimed in the case of other commodities. This may be explained by the fact that initial efforts to regulate surface mining have been primarily concerned with coal. In 1967, in six of the states with laws, more than 50 percent of the land disturbed by surface coal mining had been reclaimed.However, these state laws have been amended frequently to strengthen reclamation requirements. Thus, it would appear that the state governments themselves often have not been satisfied with the degree of reclamation achieved.

95 Destruction of land and water resources and natural beauty through surface mining represents a serious problem insofar as preservation of the environment is concerned. Recent concern over the problem merited provision for its study in the Appalachian Regional Development Act of 1965. The Act contained a section which directed the Secretary of the Interior to make a survey of strip and surface mining operations in the United States, and to submit to the President recommendations for a program of reclamation. The recommendations have been completed, and pertain to both repair of past damage and prevention of future damage. n45

95 n45 Ibid. at pp. 104-8.

95 To prevent future damage, the report of the Secretary recommends that

federal standards and reclamation requirements be drawn up as a basis for regulating future surface mining activity. These standards would be used to review state surface mining regulations, and to gauge the adequacy of state programs. In lieu of state legislation, the federal requirements would be imposed upon the surface mining industry.To repair past damage, the report recommends that the federal government share reclamation costs with state governments to rehabilitate abandoned surface-mined lands. This program would include purchase of privatelyowned lands by the federal government in cases where this was deemed in the public interest. These recommendations have not yet been adopted.

{96} Surface mining in other countries is also regulated to control future use of mined lands. In Germany, for example, mining and reclamation are considered an integral operation. n46 Mining methods depend upon the type of soil overlying the coal, and future use to which the land is to be put. Fertile surface layers of soil are segregated during mining, and replaced on the surface to ensure the future productivity of the reclaimed land. Similar procedures are required in Great Britain. There, land suitable for agricultural purposes is placed in the hands of the government immediately after mining and reclamation for a period of intensive care and management. n47 After five years, the land is returned to the farmer for agricultural use.

96 n46 W. Knabe, "Methods and Results of Strip-Mine Reclamation in Germany," The Ohio Journal of Science, Vol. 64 (1964), pp. 75-100.

96 n47 W. M. Davies, "Bringing Back the Acres," Agriculture, Vol. 70 (1963), pp. 133-38.

96 In the United States, and elsewhere, some of the major side effects of surface mining are "internalized" through regulation. Similar results might be obtained through a system of charges or payments. n48 Charges might be levied, for example, for discharge of acid mine water or sediment into adjacent streams. Unfortunately, there are not sufficient data for comparing the effects of regulation with those which might be realized through such alternative schemes.

96 n48 D. B. Brooks, op.cit. note 36 at pp. 39-41.

96 The second major source of pollution of the landscape of concern to the mineral industries is solid wastes. The disposal, control, and reclamation of waste products resulting from the extraction, processing, and utilization of mineral substances are important technological and economic factors in the effective conservation of mineral resources.

96 In 1965, the annual rate of accumulation of solid wastes arising from the extraction, processing, and utilization of minerals and fossil fuels was about 1.1 billion tons. n49 Seven of the mineral-based industries contributed about 80

percent of these wastes. These industries were copper, iron and steel, lead, zinc, alumina, phosphate rock, and bituminous and anthracite coal. By 1980, it is estimated that the rate of accumulation of wastes will increase to 3.3 billion tons. n50 This does not include wastes associated with the recovery of oil from shale, which is expected to be in operation on a commercial scale by 1980.

96 n49 Information supplied by the U.S. Bureau of Mines.

96 n50 Ibid.

96 Between 1942 and 1965, about 19 billion tons of solid wastes were produced by the mineral industry. In disposing of this material, approximately 2 million acres of land surface have been covered with waste products. This area is equivalent in size to the State of Delaware. Most of this land is unproductive, and will remain so, unless costly reclamation work is undertaken.

96 Most of the current annual accumulation of solid wastes produced by the mineral and fossil fuel industries comes from materials discarded at open pit mines, mills and coal preparation plants, blast furnaces, smelters and refineries or processing plants. The bulk of mine wastes produced at active underground mines is returned underground to fill mined-out areas and to provide a floor or platform for mining equipment.

96 Location of waste piles is frequently the most critical factor posed by solid waste disposal. Copper and iron ore mines, for example, are among the largest producers of solid wastes. However, for the most part, copper and iron mines are located in sparsely settled areas In such areas, disposal sites are abundant and land values low. On the other hand, the smaller quantities of waste products discarded by the coal, electric power, and phosphate rock industries pose much more intensive problems because these industries are usually located in densely populated areas.

96 Accumulations of mineral or fossil fuel wastes pose both health and safety problems. Billions of tons of unattractive barren piles of waste mar the natural beauty of the land. Dust from dried-out piles of waste, and smoke from burning culm banks contribute to air pollution Gob piles from coal refuse produce acid drainage problems. Other types of waste contaminate water supplies with salt and other noxious material. Use or stabilization of these wastes are the only viable means for controlling pollution.

96 The wastes generally consist of immense tonnages of materials discarded by selective mining or following the recovery of significant mineral values by milling or smelting. Often, mineral values in waste piles comprise only 2 or 3 per cent of the discarded material. Only rarely can such low-grade ore be reprocessed to extract additional minerals at a profit. n51 Some mineral wastes

are suitable for disposal as mine fill, railroad and highway road ballast, and land fill. Other wastes, such as fly ash, can be utilized as raw materials for making concrete, cement blocks, and brick. n52 However, the demand for wastes for these uses is small in relation to the amount of wastes produced.

{97} n51 K. C. Dean, H. Dolezal, and R. Havens, "New Approaches to Solid Mineral Wastes," Mining Engineering, Vol. 21 (1969), pp. 59-62.

97 n52 G. C. Gambs, "Power Plant Ash - A Neglected Asset," Mining Engineering, Vol. 19 (1967), pp. 42-44.

97 Several means exist for stabilization of relatively fine-sized wastes which constitute the chief sources of air and water pollution. These include physical, chemical, and vegetative methods of stabilization. n53

97 n53 These methods are discussed by K. C. Dean et al., op.cit. note 51.

97 Fine tailings may be stabilized by covering them with rock and soil from adjacent areas. They also may be covered with bark or straw. Or, windbreaks may be constructed. Chemical stabilization involves reacting the waste with a reagent to form a water and air resistant crust or layer. Among the reagents commonly recommended are sodium silicate, lime, redwood bark extracts, amines, acetate salts of amine, dicalcium silicate, bituminous base products, elastomeric polymers, and resinous adhesives.

97 Vegetative stabilization often poses some difficult problems. Mill wastes are usually deficient in plant nutrients or contain materials noxious to plant growth. Tailings and other fine wastes usually must be covered to a depth of four inches or more with soil and fertilized prior to seeding. If care is taken in site preparation, a satisfactory vegetative cover usually may be established.

97 Disposal of radioactive wastes poses special problems. High-level solid wastes from reactor and chemical separation facilities are usually buried in a central burial ground. n54 Such wastes are placed in unlined trehches 20 feet deep, and covered with at least five feet of soil. Some wastes are encased in concrete.

97 n54 S. D. Reichert, "Geology Plays an Important Role in Radioactive Waste Management," Mining Engineering, Vol. 20 (1968), pp. 98-103.

97 Uranium mill tailings are impounded in large tailing ponds. n55 The major concern with radioactive tailings is to stabilize them so that they are not windblown into nearby streams or over populated areas. Tailing piles are usually graded and covered with earth. Where practical, these piles are planted with vegetation for stabilization.

97 n55 R. G. Beverly, "Unique Methods are Required for Uranium Mill Waste," Mining Engineering, Vol. 20 (1968), pp. 52-56.

97 The economic utilization of certain types of metallic scrap, such as automobile bodies, also poses a significant problem. Changes in the technology of steel making have made this type of scrap less desirable for reuse.New technology, which will allow the economic reuse of old automobiles, refrigerators, and other durable goods is badly needed. Recycling these discarded metal products into useful commodities, rather than disposal into auto graveyards and junk piles, would contribute materially to the preservation of the environment.

97 At the national level, waste disposal is regulated under provisions of the Solid Waste Disposal Act of 1965.This Act is jointly administered by the Office of Solid Wastes, U.S. Department of Health, Education, and Welfare and the Bureau of Mines, U.S. Department of the Interior. n56

97 n56 U.S. Congress, op.cit. note 11 at p. 90.

97 The major impetus of the federal law is on research, technical development, demonstration, and planning for purposes of preventing and solving solid waste problems.With respect to mineral resources, the program has concentrated on areas where improved recovery systems would reduce mineral losses and the volume of products discarded, and has endeavored to develop methods to recover valuable metals and minerals from various types of waste.

97 As previously noted, 20 of the 50 states regulate the surface mining of minerals. Many of these laws pertain primarily to coal. Only six states regulate the surface mining of all commodities.Thus, in many cases, pollution resulting from surface mining is not controlled by state laws. Nor is disposal of solid wastes produced in the course of extracting, processing, and utilizing mineral substances adequately regulated. In view of the magnitude of the problem, which will assume even greater proportions in the future, this is a neglected area in environmental preservation. Studies of solid waste problems and methods at the state and local levels are urgently needed. Results of these studies should foster legislation which will provide the most economic solutions to the solid waste disposal problems currently confronting the mineral industry.

{98} [From Mining Congress Journal, March 1971]

SELECTED READINGS

ECONOMICS

PRESS SERVICE

113 NATIONAL COAL ASSOCIATION

113 Coal Building 1130 Seventeenth Street, Northwest Washington, D.C. 20036 NAtional 8-4322

113 (For Sunday a.m. s, Sept. 19, 1971)

113 COAL PRODUCTION HIGHEST SINCE 1947 WITH VALUE OF $3.8 BILLION, BAGGE SAYS

113 WASHINGTON, Sept. 18 - Carl E. Bagge, president of the National Coal Association, said today bituminous and lignite coal miners produced about 603 million tons of coal valued at almost $3 .8 billion in 1970. It was the first year since 1947 that production had exceeded 600 million tons.

113 Underground mines produced 339 million tons valued at $2 .5 billion and surface mines 264 million tons valued at $1 .3 billion, Mr. Bagge said in releasing a 1970 economic and production analysis prepared by NCA economists.

113 "aside from the increase in production and the significant economic impact of the coal industry, the point that really stands out in the figures prepared by our staff is the great contribution being made by the surface mining industry to the totals," Mr. Bagge said. "Without surface-mined coal our industry simply would be unable to meet the demands now being placed upon it by the electric utility industry, which is by far the largest single customer for coal and the biggest user of surface-mined coal."

113 The NCA study was made in preparation for hearings before the Mines and Mining Subcommittee of the House Interior Committee next week on proposals for Federal regulation of strip mining. NCA has previously announced that it is not opposed to legislation requiring surface-mine operators to meet Federal standards in land reclamation, but wants to leave the primary job of developing specific regulations to the states because of climatic and topographical variations.

{114} Mr. Bagge said the study, based on preliminary figures, shows that in 1970:

114 1. There were 111,517 production and related workers in coal mines, 89,445 working underground and 22,072 in surface operations.

114 2. The addition of supervisors and on-site office workers brought total employment in bituminous and lignite mines to 127,794.

114 3. The total payroll was $1.2 billion, of which $9 54 million went to underground workers and $248 million to surface miners.

114 This is the breakdown, based on preliminary figures for 1970, for the seven principal coal producing states:

114 West Virginia - production, 144 million tons, with 116 million underground and 28 million surface; total value, $1,142 million, with $939 from underground operations and $2 03 million from surface operations; employment, 41,452, with 36,403 in underground operations and 5,049 surface; payroll, $379 million, with $344.5 million underground and $3 4.7 million surface.

114 Kentucky - production, 125 million tons, 62.61 million underground and 62.69 million surface; total value, $712 million, with $422 million underground and $2 89 million surface; employment, 22,418, with 16,659 underground and 5,759 surface; payroll, $194 million with $143 million underground and $5 1 million surface.

114 Pennsylvania - production, 80 million tons, 55 million underground and 25 million surface; total value, $585 million, $450 million underground and $1 35 million surface; employment, 20,936, with 16,101 underground and 4,835 surface; payroll, $211 million, with $1 59 million underground and $52 million surface.

114 Illinois - production, 65 million tons, 32 million underground and 33 million surface; total value, $320 million, with $1 71 million underground and $1 49 million surface; employment, 8,284, with 5,391 underground and 2,893 surface; payroll, $87 million, with $55 million underground and $32 million surface.

{115} Ohio - production, 55 million tons, 18 million underground and 37 million surface; total value, $262 million, with $9 8 million underground and $1 64 million surface; employment, 8,207 with 4,168 underground and 4,039 surface; payroll, $84 million, with $41 million underground and $4 3 million surface.

115 Virginia - production, 35 million tons, 28 million underground and 7 million surface; total value, $246 million, with $213 million underground and $3 3 million surface; employment, 11,077 with 9,423 underground and 1,654 surface; payroll, $96 million, with $82 million underground and $1 3 million surface.

115 Indiana - production, 22 million tons, 2 million underground and 20 million surface; total value, $102 million, with $12 million underground and $90 million surface; employment, 2,105 with 572 underground and 1,533 surface; payroll, $23 million, with $6 million underground and $1 7 million surface.

{116} [From Natural Resources Journal, Vol. 6, No. 1, January 1966]

SELECTED READINGS

RECLAMATION

{183} [From the Wall Street Journal, May 24, 1971]

183 HIDING THE SCARS - SOME STRIP-MINED LAND NOW IS BEING RECLAIMED, BUT TASK IS ENORMOUS

183 TODAY'S MASSIVE MACHINERY MAY BAR FUTURE RECOVERY; TOUGH LEGISLATION URGED

183 How to Make Indian Mounds

183 (By Everett Groseclose)

183 Gene Lanning, a maintenance supervisor for Ohio Ferro Alloys Corp., likes nothing better than to see Friday afternoon roll around. As soon as the whistle blows at the factory in Philo, Ohio, he jumps into his camper and roars out into the sticks.

183 In southeastern Ohio, weekend camping is as common as strip mining for coal - and that's really common. One thing, however, sets Mr. Lanning apart from outdoorsmen in other parts of the country, and that is his favorite camping ground.

183 "To look at this," Mr. Lanning declares as he waves his hand to indicate the wooded hillsides and ponds that stretch for miles southward from the hamlet of Cumberland, "you might never know it's been strip-mined. Why, the way it is now, it's almost as good as it was before the miners came in." Streams and ponds are alive with fish; deer hunting rates as some of the best in the state; beaver and muskrat are trapped during the winter.

183 It hasn't always been that way. Barely 20 years ago the valley that yawns southward from a small mountain known as Windy Hill looked more like a moonscape than a landscape, the handiwork of miners in pursuit of coal. Hundreds of acres, often as far as the eye could see, were chewed up and spit out by giant power shovels, leaving a terrain of jagged rock, deep trenches and mountains of raw, desolate earth.

183 ENVIRONMENTAL DESTRUCTION CONTINUES

183 Throughout the Appalachian coal belt, thousands of acres, laid waste by miners as soon as they had scooped out the last chuncks of coal, are still the way the countryside near Cumberland once was. Moreover, such environmental destruction is still going on, because strip mining for coal, one of the cheapest of industrial fuels, continues to grow. Thus, the coal-mining industry is booming, particularly in states such as Ohio, Pennsylvania, Kentucky and Tennessee.

183 But changes are clearly in the wind. Two counties in Kentucky have outlawed strip mining. In West Virginia, the state legislature has enacted a two-year ban on strip mines in 22 counties so far untouched by them. In 33 other counties, strip mining remains legal, but efforts to outlaw it are believed to be gaining support. And in Ohio, a bill backed by powerful conservationists would, among other things, require strip miners to restore land to its original contour.

183 In addition, President Nixon recently proposed federal regulations that would require all states to set standards for reclamation within two years. But Rep. Ken Hechler, a West Virginia Democrat who calls the Nixon proposal "toothless," wants faster and more decisive action. He introduced a bill that would ban strip mining for coal within six months after enactment and provide federal funding of reclamation in a limited number of instances.

183 THE HAVOC OF STRIP MINING

183 Whether legislation to control strip mining and force reclamation of old sites will ever get through Congress remains to be seen. But a visit to southeastern Ohio, where two of the country's largest strip-mine operators have been working and reclaiming some land for years, gives an observer a fairly good picture of the havoc brought by strip mining and what a certain amount of land might eventually look like if stiff reclamation laws are passed. It also helps explain why many students of strip mining are convinced that reclamation of land currently being stripped by mammoth machines may be impossible.

{184} "The first thing that hits you when you get into strip-mining country is the mind-boggling immensity of the problem," says Richard L. Lancione, a lawyer in Bellaire, Ohio. He heads a group called Citizens Concerned About Strip Mining, which is sponsoring the Ohio law. "Literally thousands and thousands of acres have been turned upside down, destroyed for all practical purposes," he says.

184 The kind of devastation Mr. Lancione is talking about is much in evidence about 10 miles west of Cumberland, where Ohio Power Co., a unit of American Electric Power Co., operates what is said to be the world's largest power shovel. Known as "Big Muskie," the machine's boom is so long the operator frequently can't see the 220-cubic-yard shovel in the early-morning fog. The

shovel, operating from the bottom of a trench, is capable of stripping off soil - called overburden - to a depth of more than 160 feet to expose a layer of coal. Once the overburden is stripped off, it is called the "spoil bank" - a term critics say is extremely accurate.

184 Surrounding the shovel are hundreds of acres of devastated earth and jagged rock. Trudging along the bottom of the trench, Walter Smith, a young forester who is superintendent of reclamation for Ohio Power, says that "as soon as the stripping is finished, the bulldozers move in to grade the surface," in

effect, shaving off cones of piled soil. After grading, Mr. Smith says, "we move in to plant seedlings."

184 THE TREE-PLANTING APPROACH

184 Ohio Power's basic approach to reclamation involves planting trees, which the company hopes may someday be reaped as lumber. "We plant about 1,000 seedlings per acre, and we reclaim about 1,300 acres per year," Mr. Smith says. But even to the untrained eye, it is clear that areas mined in recent years can never regain their original appearance and vegetation, largely because mining machines in use today leave such devastation.

184 Areas mined years ago, generally with much smaller equipment that left much smaller scars, are usually the spots that companies point to with pride as having been reclaimed. And, indeed, some such areas are relatively attractive. For instance, the wilderness area frequented by Mr. Lanning of Ohio Ferro Alloys was mined with small equipment more than 25 years ago.

184 Trees that were planted then are now up to 40 feet tall and 18 inches in diameter. They help hide the ugly "final cuts" - trenches more than 50 feet deep on their uphill side left when the shovel made its final pass. How such areas would look today if larger mining equipment had been used is sheer guesswork. But critics familiar with the techniques of mining agree with 47-year-old Mr. Lanning, who has watched strip mining all his life, when he says he believes that "it would look absolutely terrible."

184 Nonetheless, such areas illustrate what can be accomplished in certain locations with reclamation. With its trees growing nicely, Ohio Power decided in 1964 to polish up its image by carving out primitive campsites in the reforested acreage south of Cumberland. Currently the company has 18 such campsites. Visitors, who must obtain a free permit from the company, can hunt on the property or fish in some of the 300 ponds the company has created - most of them by damming up final cuts every few hundred yards. "On the weekends during the summer, I'll give you a dollar for every pond you can find that doesn't have a fisherman on it," Mr. Smith says.

184 If Ohio Power's reclamation projects are partially successful, they are also partly "showcase" efforts. Others have gone even further. A striking example of showcase reclamation and what can be done if enough money and effort are pumped into the job can be found near the village of Cadiz, about 35 miles northeast of Cambridge, Ohio. There, Hanna Coal, a division of Consolidation Coal Co., has built a 400-acre public park. Called Sallie Buffalo, the park comprises a 27-acre lake, parking space for house trailers, a lodge for parties and facilities for picnicking and camping.

184 Thousands of lovers of the outdoors visit Sallie Buffalo each year, and long-time residents of the area are the first to say the park is a vast improvement. Walking along the shore of the lake as he flips a lure into the water and then retrieves it, Herman Eberling, a retired steelworker, tells how he has "lived around here all my life." Mr. Eberling adds: "This park is certainly a lot better than the way it was when the country was all torn up, but it's still old beat-up mining country."

{185} PROVING IT CAN BE DONE

185 C. Arthur Wallace, general superintendent for land use and reclamation for Hanna Coal, estimates that Hanna has put $1 30,000 into the park and its facilities. "Yeah," he concedes, "it's awfully expensive - too expensive to do very much of it. We did it mainly just to prove it could be done, but I think it's worthwhile from everyone's viewpoint."

185 Hanna Coal has also been working on a far more economical approach to reclamation near Cadiz. The company has planted 12,000 acres of strip-mined land with a perennial legume called crown vetch. In certain types of soil, the legume grows well and cattle thrive on it.

185 Showing a visitor across the gently rolling pastureland stocked with registered Hereford cattle that the fussiest rancher would take pride in owning, Mr. Wallace says that Hanna Coal is "making a tiny profit" on its cattle operations. "The company keeps asking me what we're going to do with all this (stripped) land," Mr. Wallace declares. "My answer is that five years from now we're going to be in the cattle business in a big way."

185 In Hanna Coal's case, that may be true. But certainly it isn't true for many other coal-mining concerns. The reason: Hanna Coal is unusually fortunate. The overburden on much of the land mined by the company is mostly limestone. Unlike so-called acid sandstone, which covers most seams - or layers - of coal, plant life grows relatively well on limestone spoil banks. Says Mr. Smith of Ohio Power: "When you've got a spoil bank that's acid sandstone, you just plant your trees and pray."

185 The type of spoil created by strip mining is indeed a crucial factor in the difficulty of reclamation. Nothing will grow on soil that contains small chunks of coal or powdered coal. The earth directly above most coal seams is heavily acid. This type of material is sometimes the last to come out of the final cut; thus it is what occasionally goes on top of the spoil bank.

185 GETTING RID OF THE "GOB"

185 In addition, numerous companies have run into difficulty in disposing of a waste product from coal that is called "gob." Essentially, gob is inferior coal. In many cases, it is removed from mined coal before the fuel is shipped to its user. Companies have tried various means of disposing of gob, usually involving one kind of attempt or another at burying it in low-lying areas and covering it over with nontoxic soil.

185 Frequently burying gob works poorly. Hanna Coal's Mr. Wallace, for instance, says that attempts to bury gob on about 250 acres near Cadiz have been only partly successful. The problem is that rainwater tends to seep through the nontoxic overlayer into the gob, drain downhill and emerge at a lower terrain level, polluting both land and streams. Such seepage often results in drainage almost the color of blood. "That water will eat the nails right out of your boots," says Donald E. Richter, field director of the Ohio Reclamation Association, a group formed in 1945 by coal-mining concerns to handle much of their reclamation work.

185 Rugged terrain also sometimes makes it impossible for miners to reclaim stripmined land. Particularly in mountainous Appalachia, experts say, the terrain is simply so rough that power shovels can make only one pass, throwing the spoil downhill. In many instances, the mountain is so steep that the spoil disperses itself as it tumbles downhill, leaving only the ugly final cut and no spoil bank to grade.

185 Most critics object the loudest to abandoning final cuts with little or no effort to reclaim the land. The reason, of course, is that the final cut is the most obvious and lasting scar. Even in countryside that isn't particularly mountainous, the final cuts are almost never filled. Instead, they are dammed up every so often, which allows the toxic materials left in the bed to be covered by water. Once these cuts are covered, the posionous effect of coal is contained. Fish, beaver and other forms of wildlife can thrive in such ponds.

185 THE COST OF FILLING

185 Still, critics decry the scars and generally contend that coal-mining companies should fill them in. Thus far, in most parts of the country, coal companies have successfully resisted drives to require them to fill final cuts. Their motivation is simple. "The cost of filling in the high wall is very, very expensive. That's why its not done," declares Mr. Richter of the Ohio Reclamation Association.Besides, he adds, "by knocking off the top of the high wall, you only ruin more surface area."

{186} Still another major reason companies are reluctant to put money and effort into reclamation projects is that they plan to mine most areas again. Take Hanna Coal's crown-vetch pastureland, for example. "We're nowhere near through mining around here." Mr. Wallace says. With the development of larger equipment capable of digging ever deeper after one of the 12 seams of coal below the surface in Ohio, companies can reach coal that wasn't possible before.

186 Typical of what has happended and what is continuing to happen is Mr. Wallace's prized pastureland. It was first mined almost 40 years ago with an eight-cubic-yard shovel. Then came a 22-cubic-yeard machine. Later came longer-boomed shovels that would move 45 and 65 cubic yards in one bite. Currently a 105-cubic-yard Hanna Coal machine is operating in the area, and larger machines, such as Ohio Power's Big Muskie, are being developed.

186 A variety of other problems also make reclamation difficult; not the least of these is time. For many areas, planting trees is the most logical step. But a year-old tree usually is barely more than a sprig one foot to three feet tall. Ten-year-old trees usually have attained a height of only 10 to 20 feet, depending on the and the soil condition. Generally trees take 20 to 25 years to mature.

186 More mundane difficulties aren't unusual, either. A constant problem for operatios attempting to grade strip-mined land is dispersal of huge chunks of rock, sometimes as large as a two-story house. "When you run into a rock so big you can't move it, you just pile dirt around it and call it an Indian mound," Mr. Wallace says.

{187} [See Illustration in Original]

{188}

Contents

188 Issued April 1968

188 TYPES OF SURFACE MINING

188 OPEN PIT. - Excavating for stone, sand and gravel, iron, or copper where a mineral deposit is found within a small area. Most quarries fall under this category. Some of these mines may be operated in one location for many years.

188 AREA STRIPPING. - Digging a series of parallel trenches in relatively flat or rolling terrain to get coal, phosphate, or other minerals. Spoil material is placed in the previous cut made; the mine resembles the ridges of a washboard with an open trench where the last cut was made.

188 CONTOUR STRIPPING. - Digging around a hillside in steep or mountainous country, usually for coal. It creates a shelf or "bench" bordered on the inside edge by a high wall that may be as much as 100 feet tall and on the outside edge by a rim and a very steep "outsolpe" covered by loose spoil material.

188 AUGER MINING. - Boring horizontally into a seam to get more coal after stripping is finished. A cutting head - as large as 7 feet in diameter - is drilled into the seam, and coal is scraped out along the auger threads.

188 DREDGING. - Removing sand and gravel, gold or other minerals from underwater or low-lying areas by a suction pump or digging device usually mounted on a floating barge. Spoil piles may resemble those from area stripping.

188 HYDRAULIC MINING. - Using a powerful jet of water to wash down or erode a bank to get gold or other precious metals. Ore is separated by differences in specific gravity as the material is fed through sluices or other devices.

STATE-FEDERAL RELATIONSHIP

INTRODUCTION

Twenty-eight states presently have surface mining and mined land reclamation laws. A summary of such laws is included. The laws are as varied and diverse in the provisions and conditions setting forth the State-Federal relationship as are the minerals which are covered. The relationship of these existing state statutes to proposed Federal legislation is of paramount concern as are those local ordinances which apply to limited types of operations such as quarrying. Several of the bills introduced require acceptable state plans for reclamation and vary in the delegation of responsibilities and duties between the Federal government and the various states. In addition several of the bills recognize problems inherent in regional effects of surface mining for example, acid drainage affecting adjoining states.

237 Following is an opinion setting forth the constitutional basis for Governmental regulation of mining activity on private lands, and highlights of the bills pending at the close of the 1st session.

{238} THE LIBRARY OF CONGRESS, CONGRESSIONAL RESEARCH SERVICE,

238 Washington, D.C., September 20, 1971.

238 From: American Law Division.

238 Subject: Constitutional basis for Government regulation of mining activities on private land.

238 This memorandum is submitted in response to your inquiry as to the constitutional basis for the regulation of mining activities on private land by the Federal or State Governments. We regret that the haste in which this material is needed has prevented the presentation of a more comprehensive and detailed discussion.

238 There is no legal right to exploit natural resources wherever they may be found. This principle, in conjunction with the police power to provide for the public health, welfare, safety and morals of the citizenry, furnishes the foundation for governmental units' endeavors to regulate mining activities. Comment, Constitutional Law - Governmental Regulation of Surface Mining Activities, 46 N.C.L.Rev. 103, 105 (1967). The constitutional right of every person to pursue a business, occupation or profession is subject to the

paramount right of the government as a part of its police power to impose such restrictions and regulations as the protection of the public may require. 16

Am.Jr.2d, Constitutional Law, sec. 313. The general rule is well settled that whenever it is necessary for the preservation of the public health, safety, morals, or peace, or for the promotion or the general welfare of the community, the legislature may prohibit absolutely the carrying on of any particular business, calling, trade, or enterprise. 16 Am.Jur.2d, Constitutional Law, sec. 321.

238 "In the exercise of its police power the state may forbid, as inimical to the public welfare, the prosecution of a particular type of business, or regulate a business in such manner as to abate evils deemed to arise from its pursuit." Great Atlantic & Pacific Tea Co. v. Grosjean, 301 U.S. 412, 425-426 (1937).

238 "The term public welfare is broad and general and its limits ill defined or undefinable. It is clear, however, that government cannot make the conduct of a legal business illegal simply because it may cause certain problems for the community. . . . Regulation of such business is, of course, permitted so long as the regulation is directed towards solving the problems involved. . . . And where it is clear that the public danger is great enough the regulation can approach prohibition." Greater Freemont, Inc. v. City of Freemont, 302 F.Supp. 652, 662 (N.D. Ohio 1968).

238 Of course, action in the form of regulation can so diminish the value of property as to constitute a constitutional taking. However, the mere fact that the regulation deprives the property owner of the most profitable use of his property is not necessarily enough to establish the owner's right to compensation. United States v. Central Eureka Mining Co., 357 U.S. 155 (1958). The characterizing of a law as prohibiting a beneficial use to which the property has previously been devoted does not reveal whether such is unconstitutional. Every regulation necessarily speaks as a prohibition. If a law is otherwise a valid exercise of the police powers, the fact that it deprives the property of its most beneficial use does not render it unconstitutional. Goldblatt v. Town of Hempstead, 369 U.S. 590, 592 (1962).

238 "A prohibition simply upon the use of property in a manner injurious to the health, morals, or safety of the community cannot, in any just sense, be deemed a taking or an appropriation of property for the public benefit. Such legislation does not disturb the owner in the control of use of his property for lawful purposes or restrict his right to dispose of it, but is only a declaration by the state that its use by anyone, for certain forbidden purposes, is prejudicial to the interests of the community." 16 Am.Jur.2d. Constitutional Law, sec. 293.

238 The power of the Federal Government to regulate mining activities on private land is probably based on the power to "regulate" interstate commerce in the Commerce Clause (Art. I, sec. 8, cl. 3) and the power to make all reasonable

laws prohibiting or otherwise regulating such activity under the Necessary and Proper Clause (Art. I, sec. 8, cl. 18). Even though there are some early judicial pronouncements that the production of coal in and of itself may not constitute interstate commerce, e.g., in City of Atlanta v. National Bituminous Coal Commission, 26 F.Supp. 606, 608 (D.D.C. 1939), aff'd. 308 U.S. 517 (1939), subsequent rulings of the Supreme Court appear to leave little doubt that regulation of an activity such as coal mining by Congress would be upheld

under the ever expanding scope of the Commerce Clause, e.g., see Wickard v. Filburn, 317 U.S. 111 (1942), Katzenbach v. McClung, 370 U.S. 294 (1964), and most recently Perez v. United States, 402 U.S. 146 (1971)). Thus, the commerce power goes beyond reaching only that which moves or has moved in interstate commerce. If an activity affects interstate commerce, or if a purely local activity would make ineffective or more difficult a Congressional regulation of interstate commerce if the local activity were left unregulated, then it would seem that Congress has the power to regulate it.

{239} Further, if a federal act is devoted to such matters as the promotion of safety and efficiency in interstate commerce, if it bears some reasonable and rational relationship to the subject over which it has assumed to act, the power is supreme and may not be denied, although it may include within its scope activities which are intrastate in character. Rosenhan v. United States, 131 F.2d 932, 935 (10th Cir. 1942), cert.den. 318 U.S. 790 (1943). It might also be argued that the purpose of Congress in enacting regulation of coal mining operations is not to technically regulate commerce but basically to protect the health, safety and welfare of citizens, an exercise which would be a police power if performed by a State. See, Annotation: Illustrations of exercise by Congress, within the general range of federal powers analogous to police power exercised by state legislatures - federal cases, 99 L.Ed. 40, supplementing 81 L.Ed. 938.

239 DANIEL HILL ZAFREN, L Legislative Attorney.

STATE-FEDERAL RELATIONSHIP: HIGHLIGHTS OF PENDING SENATE BILLS

HIGHLIGHTS OF S. 77

249 (Mr. Nelson, January 25, 1971)

249 Finding that certain detrimental results follow the practice of surface mining, the bill proposes an eight-point program administered by the Secretaries of Agriculture and Interior to reclaim damaged lands and prevent further detriment. Among the goals are:

249 The establishment of Federal reclamation standards and criteria;

249 Encouragement of State enactment of equivalent requirements;

249 Funds for R. & D, technical assistance and demonstration projects; and,

249 Acquisition of mined lands to achieve their reclamation.

249 Secretaries are directed to establish standards and requirements for the reclamation of previously mined lands, and for the regulation of all future surface mining. In establishing these requirements the Secretaries are to consult with a national advisory committee appointed by the President, and with any regional advisory groups the Secretaries may have created. The Federal standards are to meet objectives cited in Title I, including a requirement for a Federal license or permit; posting of a performance bond; time limits for reclamation work; and a means to prohibit surface mining in areas where reclamation is considered unfeasible. Detailed appeal procedures are spelled out in Title I, as are the requirements for State plans and appeals concerning their non-acceptance by the Secretaries. An accepted State plan is required for participation in programs under Title II and III of the bill.

249 Title II provides financial aid to State and local governments to reclaim lands which they own which have been damaged by previous strip mining. The program would be administered by the Secretary of Agriculture and would terminate by January 1, 1988. No grant could exceed the identifiable benefits or 75 per centum of the costs of the project.

249 Title III authorizes grants to State and local agencies for research and development and for technical advisory assistance. The Secretaries would administer the grant programs which would terminate not later than January 1, 1988.

249 The Secretary of Agriculture is authorized to furnish financial and other assistance to achieve the reclamation of privately owned lands which have been adversely affected by surface mining.

249 Title V authorizes the Secretary of Interior to acquire unreclaimed lands by exchange, donation or purchase in order to effect their rehabilitation. He may do so only under conditions specified in the bill. Generally the lands to be acquired must be within or adjacent to the boundaries of an established Federal unit. Further, the land must be within the boundaries of a project approved under the terms of title IV, and no State or local government desires to acquire the land.After reclamation, the land may be managed, transferred or disposed of at the judgment of the Secretary.

249 The appropriation of such sums as may be necessary is authorized, as is the establishment of a special "mined lands reclamation revolving fund" in the Treasury.

249 HIGHLIGHTS OF S. 630

249 (Mr. Jackson, February 5, 1971)

249 Provides for the establishment, within 2 years of plans formulated by the States for the control of adverse effects of surface mining. The bill provides a list of general requirements which must be met before the program can be approved by the Secretary of the Interior. Federal share of cost of any State program shall not exceed 50 percent.

249 The Secretary shall issue regulations for surface-mining operations in States which have not submitted an acceptable plan within the 2-year period. He may grant a 1-year extension if he believes the State will submit an acceptable plan within the additional year.

{250} The bill requires publication in the Federal Register of any proposed regulations by the Secretary, and a 60-day period for the submission of views or arguments on the proposed regulations. Provision is made for public hearings if requested by any person adversely affected by the proposed regulations.

250 If a satisfactory State plan is submitted after the Federal regulations have been issued, the Federal regulations will terminate within 60 days after approval of the State plan. The Federal regulations may be reinstated if the Secretary subsequently withdraws his approval of the State plan.

250 The bill provides authority to the Secretary to conduct inspections and investigations (sec. 10); obtain injunctions, preventing operation of, or sale of products from, noncomplying mines (sec. 12); and assess and collect specified penalities in the case of violations.

250 The Secretary is authorized to conduct and promote research and similar activities related to the carrying out of the provisions of the act.

250 The bill authorizes the appropriation of such sums as may be necessary to carry out the purposes of the act. It also creates a revolving mined lands reclamation fund.

250 HIGHLIGHTS OF S. 993

250 (Mr. Jackson, Mr. Allott, Mr. Cooper, February 25, 1971)

250 AND S. 1176

250 (Mr. Jackson, Mr. Allott, March 10, 1971)

250 Provides a 2-year period in which the States may develop, after public hearings, environmental regulations for mining operations on all but Federal and Indian trust lands within the State. Fifteen criteria are listed in the bill and the Secretary of the Interior is required to furnish additional guidelines within 30 days of enactment. The purpose of the guidelines is to assure State regulations which give mining operators flexibility to choose the most economically efficient means of meeting the requirements.

250 An Advisory Committee consisting of representatives from the Departments of Agriculture, Commerce, the Environmental Protection Agency, the TVA and the Appalachian Regional Commission is required to advise the Interior Secretary in developing the guidelines.

250 The Interior Secretary must solicit the views of Federal agencies principally interested in such regulations before approving any State regulations. State regulations are deemed approved if no action is taken within 180 days of their submission.

250 If, in continually reviewing State regulations, the Secretary finds that, for any reason, the regulations are inadequate he shall notify the State suggesting appropriate action, remedies or revisions. In the absence of appropriate State action, the Secretary may withdraw approval of the State regulations and issue Federal regulations.

250 Federal regulations are required in the event a State does not submit satisfactory regulations within the 2-year period initially available for that purpose.

250 Where the Secretary administers and enforces a program in a State he shall recover the full cost of administration and enforcement through use of mining permit charges.

250 The Secretary is authorized to carry out such inspections and investigations as are necessary for the purposes of the act.

250 Injunctions are authorized to prevent operations in violation of Federal regulations issued under the act or State regulations being enforced by the Secretary; and to prevent the placing in commerce of minerals produced by an operation in violation of State regulations.

250 Penalties for failure to comply after notice of violation of Federal regulations are set at $1 ,000 per day; and in the event of knowingly violating any such regulation, a fine not to exceed $10,000 or a year in prison, or both.

250 The Secretary is authorized to conduct or promote research to carry out the purposes of the act.

250 Grants to States for the purpose of developing, administering, and enforcing environmental regulations are authorized on a declining basis over a 5-year period.

250 The Department of Agriculture may be utilized in the reclamation of areas affected by surface mining.

{251} Federal lands are protected by the requirement of title III that heads of agencies or departments who administer lands on which mining is permitted must issue regulations to assure the same degree of protection and reclamation as is required on other lands within the State in which the Federal land is located.

251 HIGHLIGHTS OF S. 1160

251 (Mr. Hansen, March 9, 1971)

251 Authorizes the Secretary of Interior to make grants to the States in order to effect a rehabilitation of areas damaged by deleterious mining practices.

251 The Act of July 15, 1955, as amended by the Act of Ocboter 15, 1962, serves as the basis of this proposal. The existing law authorizes the Secretary of Interior to make grants on a matching basis to the Commonwealth of Pennsylvania for the "control and drainage of water" which would otherwise result in the flooding of anthracite coal formations; and for the sealing of mines and the filling of voids in abandoned mines.

251 S. 1160 would remove the restrictions limiting the program to anthracite coal fields in Pennsylvania. Grants to the Several States "to seal and fill voids in abandoned coal mines and abandoned oil and gas wells, and to reclaim and rehabilitate lands affected by the strip and surface mining and processing of coal and other minerals . . . " are authorized.

251 Section 2 provides that grants may be made in advance or by way of reimbursement, under conditions established by the Interior Secretary. A maximum Federal share of 75 per centum of the total cost of mined area

restoration projects is imposed. Reasonable land acquisition costs may be included in the non-Federal share, providing the land is acquired after the date of enactment of the Act.

251 Section 3 authorizes the appropriation of funds needed to carry out the purposes of the Act for three fiscal years ending June 30, 1974.

251 HIGHLIGHTS OF S. 1240

251 (Mr. Church, Mr. Jordan of Idaho, Mr. Mansfield, Mr. Metcalf, Mr. Moss, March 16, 1971)

251 The Secretary of the Interior is authorized to designate public lands on which no prospecting or exploring for minerals with bulldozers or other mechanical earthmoving equipment is allowed. Before banning the use of such equipment, the Secretary is required to determine that environmental factors are such as to make the use of such equipment inadvisable, or that the use of the equipment would result in irreparable damage to the land surface.

251 Publication of detailed boundary descriptions of such protected lands must be published in the Federal Register before the provisions cn become effective.

251 After enactment, any individual or organization seeking to use bulldozers or other related earthmoving equipment to explore or propsect for minerals on any public lands must first file with the Secretary (1) a statement of intent which includes a description of the area, operation, and equipment involved; and (2) a performance bond in an amount determined by the Secretary of Interior to be adequate to assure restoration or reclamation of the land surface following exploration activity.

251 Actions by the Interior Secretary which affect national forests must first be approved by the Secretary of Agriculture.

251 Such regulations as are issued by the Interior Secretary to carry out the purposes of the act are to be published in the Federal Register.

251 HIGHLIGHTS OF S. 1498

251 (Mr. Nelson, Mr. McGovern, April 5, 1971)

251 Provides for a program operated by the Environmental Protection Agency which would close all surface coal mines within 6 months and require their reclamation, and would establish national environmental standards for

underground coal mines within 90 days.

251 The bill requires the several States to adopt within 6 months after the establishment of the Federal standards a State plan for the implementation of those standards. Public hearings are required in establishing the State plan. The Administrator of the EPA is required to impose a Federal implementation plan in the absence of a satisfactory State plan. General requirements for the State plan are listed in the bill.

{252} Requires a halt to underground coal-mining operations in national forests after 120 days from enactment of the act until regulations are promulgated which assure there will be no adverse onsite or offsite effects from such mining.

252 Underground mining of coal in any area established as a wilderness area is prohibited.

252 The bill authorizes the Administrator to enter into agreements to reclaim abandoned and inactive surface and underground coal mined lands owned or acquired by a State or local jurisdiction. Federal share of the cost may not exceed 90 percent. Public access to and use of the reclaimed lands is required.

252 Provision is made for Federal assumption of up to 90 percent of the cost of acquiring surface or underground mined lands by a State or local government to carry out the purposes of this Act.

252 Federal enforcement of implementation plans is authorized as is the bringing of civil suits against violators. First offense convictions are punishable by a fine not exceeding $2 5,000 for each day of violation, or by 1 year of imprisonment, or both. Convictions beyond the first are punishable by

a fine of $5 0,000 per day of violation, or by imprisonment for up to 2 years, or both. An informer's fee in the amount of one-half of the fine is authorized for those providing information leading up to a conviction.

252 Fines up to $1 0,000 and imprisonment for up to 6 months are authorized in the event of the filing of false statements or tampering with monitoring devices.

252 The Administrator may require mine operators to maintain records, make reports, install monitoring equipment, and sample emissions to the extent necessary to carry out the provisions of the act.

252 Citizen suits against any person or governmental instrumentality,

including the Administrator, alleged to be a violation of an implementation plan or the act, are authorized.

252 No Federal agency may contract with any operator who is convicted of any offense under this act for the procurement of goods, materials, and services to perform such contract at any coal mine at which the violation which gave rise to the conviction occurred.

252 The President is required to issue within 180 days to all Federal contracting and granting agencies an order to effectuate the purpose and policy of the act, and setting forth procedures, sanctions, penalties, and other necessary provisions. An annual report to the Congress by the President on implementation and progress on this section is required.

252 HIGHLIGHTS OF S. 2455

252 (MR. MOSS, AUGUST 5, 1971)

252 Within 180 days of enactment, each surface mine whose products enter or affect commerce must obtain a permit to operate from the Secretary of Interior.

252 Within 90 days, the Interior Secretary, in consultation with the Administrator of the Environmental Protection Agency and the Secretary of Agriculture, shall develop mandatory standards for surface mining operations and reclamation. The standards must insure that (1) applicable air and water quality standards will not be violated; (2) erosion, flooding, subsidence, damage to fish and wildlife or property, and other hazards will be controlled or prevented; and (3) air pollution by dust or burning refuse are prevented.

252 Before becoming effective, these standards must be approved by the Administrator of EPA and must be published for comment in the Federal Register. Provision is made for public hearings on the standards, if needed.

252 The Secretary is authorized to establish special standards governing the method of surface mining on steep slopes.

252 Detailed requirements for permit applications are cited, which include the written consent of the owner of the surface of the land on which the mining is proposed, to allow entry by the operator or Federal agents for the purpose of reclamation or inspection for a period of five years after the operation is completed or abandoned. A complete reclamation plan and payment of an application fee are also among the requirements.

252 Before beginning operations, the permittee must post a performance bond

in an amount determined by the Interior Secretary. The bond liability is for the period of the operation and five years thereafter, unless released sooner under provisions of the Act.

{253} Provision is made for the renewal and revocation of permits by the Secretary.

253 Reclamation sufficient to restore the land to at least the same use it had prior to mining is required.

253 Reports on a quarterly and annual basis are required to be filed with the Secretary. Reports are to contain information on the number of acres mined and the number reclaimed.

253 Provision is made for release of bond under specified conditions following inspection and approval of reclamation work.

253 Title II provides that a State may establish and operate a program for regulation of surface mining in lieu of Federal regulations if the State plan is approved by the Interior Secretary. The Secretary is required to approve a State plan if, in his judgment, it meets 15 criteria spelled out in section 201. In general the criteria reflect the requirements for the Federal regulations required by Title I. In addition, designation of a single State agency with the responsibility for administration and enforcement of the program is required, as is assurance that the agency designated has the regulatory and other authority necessary to carry out the purposes of the Act. Also required are full participation in the preparation of the plan by Federal agencies and other interested parties; and compatability of regulations with those of adjacent States.

253 The Secretary is required within 60 days to issue guidelines sufficient to reduce or prevent adverse environmental effects of surface mining. These guidelines must be approved by the Administrator of EPA before they become effective.

253 The Secretary must solicit the views of interested Federal agencies before he approves any State submitted regulations. In the event State operation proves unsatisfactory and is not improved in line with suggestions by the Secretary, approval of the State program shall be withdrawn and the Federal program substituted in its place.

253 Authorization of civil actions and injunctive relief to insure compliance with the purposes of the Act is included.

253 A strip mining land restoration fund is established, into which shall be paid all fines and forfeitures collected pursuant to the Act.

253 The Interior Secretary is authorized to acquire unreclaimed surface mined land and interests therein and to effect their restoration.

253 The Secretary is authorized to conduct or promote research or training programs to achieve the purposes of the Act.

253 Grants to the States are authorized for the purpose of assisting in the development, administration and enforcement of environmental regulations under title II of the Act.

253 The Secretary is also authorized to provide to the States nonfinancial assistance in administration and enforcement of their regulations.

{254} HIGHLIGHTS OF S. 2727

254 (Mr. Jackson and Mr. Allott, October 21, 1971)

254 Covers all locatable lands owned by the United States except those which are subject to a higher use, require environmental protection, or subject to a prior right.

254 Six months after enactment, no mineral prospecting for commercial purposes without a prospecting license. Licenses issued each state upon payment of fee for two-year period, conditioned upon stipulations for protection of the environment. Mineral may not be sold under this license.

254 Permits for exploration, development and production issued to first person applying. Permittee obtain an exclusive right for 5 years (and 5 year renewal) to not more than 640 acres and no more than 20,480 acres in one state. Detailed provisions for renewal, rental, royalty and patent.

254 Reclamation and operation plan required of permittees, patentees and owners of unpatented mining claims. Secretary to issue environmental regulations requiring consideration of air and water quality standards, filing of engineering maps, standards to meet state requirements. Establishes advisory committee. Right of entry retained by Secretary. Sanctions include closing down operation, cancellation of permit, license. Civil penalty $1,000 for each day of violation, crin-inal $1 0,000 or imprisonment 1 year, or both. Enforcement Bond requirements to be determined by Secretary. Performance Bond to insure reclamation requirements.

254 HIGHLIGHTS OF S. 2777

254 (Mr. Gravel, October 29, 1971)

254 One hundred and sixty days after effective date of Act each surface mine, the products of which enter interstate commerce or the products of which affect interstate commerce, are subject to the Act and persons engaging in extraction of minerals from such surface mines must first obtain a permit.

254 Application for permit (accompanied by a fee to be set by regulation) must include a complete plan of reclamation for the area to be affected.

254 Secretary may approve, hold a hearing, set bond to be not less than $1,000 per acre to be reclaimed and no less than $1 0,000 for any strip mine operation. Decisions subject to judicial review.

254 Provides for a strip mine reclamation revolving fund consisting of $1 00 million to be appropriated and moneys from fines, fees, bond forfeitures and sale, lease or rental of reclaimed lands.

254 Authorizes acquisition by the U.S. of unreclaimed lands and reclamation using fund moneys. Reclaimed lands may be sold at fair market value.

254 Secretary may revoke permit after a public hearing. Citizens may petition for public hearing with regard to compliance of operators.

254 Six months following enactment, Secretary and Commission develop mandatory standards, including reclamation programs. Standards are to consider the nature of the industry and regional differences and must be published to afford interested persons to comment and provisions made for public hearing.

254 Establishes an advisory commission of nine - three appointed by Interior, three by Agriculture and three by EPA.

254 Provides penalties in the form of fines not to exceed $5 0,000 or imprisonment not to exceed 2 years or both. Directors, officers, or agents of corporations are made subject to the penalty clause.

254 Upon petition and a showing that a state law is consistent with Federal regulation and sufficiently enforced, states may be delegated authority to enforce provisions of Federal Act. Secretary maintains surveillance over state enforcement and report annually to Congress.

254 No state law in effect on date of effective date of Act or subsequently adopted shall be superseded by Federal Act except where inconsistent with Federal Act.

{255} HIGHLIGHTS OF S. 3000

255 (Mr. Baker, Mr. Cooper, December 13, 1971)

255 TITLE I

255 Section 101 limits application of the bill to any coal surface mine the products of which enter commerce or the operations of which affect commerce.Permit is required of any new operation or significant increase in operations after the effective date of Act, 270 days after enactment, no activity without a permit.

255 EPA is administering authority in consultation with Secretary of Agriculture and Interior and promulgates regulations for reclamation. Regulations subject to judicial review.

255 Administrator issues permits for one-year periods until a state regulatory permit system is in effect and issues regulations which will require a plan of reclamation and an estimate of cost of reclamation per acre. Administrator has authority to disapprove a permit application or renewal thereof if there are undue hazards to adjacent lands or waters and terminate permits for noncompliance. Performance bond based on reclamation requirements. In addition to revocation powers, fines up to $10,000 can be levied for fraud and up to $5 ,000 per acre for violation of reclamation requirements.

255 TITLE II

255 Requires each state within 8 months of the promulgation of guidelines by the Administrator to adopt a program for regulation of surface mining for coal, provided, there is a state permit system, notice and opportunity for public hearing on each application. Adjoining states whose lands or waters are affected may submit written recommendation to the permitting state. Permits are terminable for cause or changed conditions.

255 There may be, upon approval by EPA, a single interstate agency responsible for enforcement.

255 If a state does not meet the requirements, EPA's Administrator may promulgate regulations. EPA given right of entry, inspection and monitoring of properties of surface coal mines.

255 Federal enforcement by order published in Federal Register and by bringing court action, including permanent or temporary injunction - judicial

review.

INTRODUCTION

THE ISSUES FROM THE HEARINGS

7 The headings held by this Committee on November 16, 17 and December 2, 1971 developed a useful record on surface mine regulation. Witnesses provided new documentation of previously identified issues. In addressing themselves to the various legislative proposals before the Committee, witnesses raised additional questions and points of view.

7 In order to review and analyze the issues, representative statements from the hearings have been selected and grouped in this section. First, those issues identified earlier in this document are listed. Following these are the points newly identified during the hearings.

7 Coal, once again, was the commodity most discussed. The extent of that discussion is reflected in the accompanying excerpts.

7 Surface mining was defended on economic grounds. Cannelton Coal Company president Paul Morton noted the efficiency of surface mining when he testified:

7 I sincerely believe that the surface mining method of extracting our Nation's coal resources is more nearly in accord with rational conservation of natural resource policy than is the deep mining for coal. By surface mining we are presently able to make a total recovery of the resource while this is not possible through deep mining. For example, in my own operations, Cannelton Coal can and will recover all 14 million tons of coal reserves presently held in fee and covered by our present 2,000-acre permit. Through the best in underground methods, we are able to extract less than 4 million tons from that same reserve. Hence, more than two-thirds of our coal would be non-recoverable if not surface mined.

7 Representative Kenneth Hechler of West Virginia cited the environmental costs which stand in contrast to efficiency:

7 Watertables are destroyed, depriving the earth of its channels of nourishment. The delicate surface fabric of life-supporting earth is cast to the bottom. Deep strata of rock and shale are pulverized and exposed to the elements, where they will leach acids and toxic minerals into the surrounding streams for generations. Mountains, now unstable, crack, slip and slide. Rains wash mud, sand and toxic substances down into the streams and rivers, filling their channels and poisoning their waters.

7 These two basic positions - economics versus environment - were heard from many witnesses who detailed various aspects of the controversy.

7 Underground mining

7 A useful corollary to the environmental damages of surface mining was contained in the testimony of several witnesses on underground mining.

7 Russell Train, Chairman of the Council on Environmental Quality, noted the extent of subsidence:

7 * * * land undermined by underground mining alone probably exceeds 7 million acres - with 2 million acres already suffering some subsidence and another two-thirds of a million acres expected to subside by the year 2000. The Bureau of Mines estimates that new underground mining will affect 4 million more acres of land in the meantime. Our actions now can prevent those 4 million acres from becoming a burden on future generations.

{8} Train added, "environmental consequences of underground mining, such as subsidence and acid mine drainage, can be very serious without adequate controls".

8 He was speaking in support of the administration proposal, S. 993 and S. 1176, which along with a number of other pending measures would impose environmental controls on underground mines as well as surface mines.

8 John R. Quarles Jr. of the Environmental Protection Agency cited the extent of damages from mining operations, then added, "a major portion of the damages which I have just mentioned results from inadequately planned and unregulated underground mining and mineral processing."

8 Energy needs and coal

8 The conservationist point of view on the widely discussed energy crisis, and the need for coal to resolve it, is typified by this testimony of the Wilderness Society representative, A. T. Wright:

8 We doubt that there is an energy crisis of serious enough proportions which demands that coal be strip mined at its present rate or, indeed that it be strip mined at all. The experts tell us that we have adequate coal reserves for the indefinite future. We are not forced to resort to resort to stripping.
Why, then, musr coal be stripped at all in view of the staggering social and environmental costs which attend it? * * * Deep mining on an almost exclusive basis seems to be the only sane answer to the catastrophic alternative of strip mining.

8 Cannelton Coal's Morton offered a starkly different view:

8 Deep mining simply does not provide the Nation with a viable alternative to surface mining.

8 National Coal Association President Carl Bagge said:

8 It is not realistic to expect that surface mined coal could be replaced by production from underground mines. While there are ample underground reserves, to produce the 264 million tons ofsurface coal mined last year would require 132 additional underground coal mines of 2 million tons annual capacity, a capital investment of $3.2 to $3 .7 billion, three to five years before full production could be anticipated and an additional 78 thousand trained underground miners.

8 Later, pointing out the contribution of surface-mined coal to the national energy supply, Bagge added, " . . . it is reasonable to assume that about one-fourth of the total electric energy generated in 1970 was produced from surface mined coal".

8 Senator Howard H. Baker testified also on this point:

8 . . . the power grids of the nation, especially those of the Southeast, are dependent to a remarkable degree on the production of coal from surface mines and this dependence cannot be withdrawn suddenly without unacceptable economic and social consequences.

8 Wright in his statement questioned the existence of any real overall energy crisis, testifying:

8 Aside from the fact that the crisis, if indeed there is one, has been induced by high pressure sales tactics and overpromotion, a part of the picture has to be the 52 million tons of coal exported annually.

8 Extensive testimony on the matter of promotion of the use of electrical energy was presented in this committee's hearings on power generation and associated problems in the Southwest.

8 Reclamation feasibility

8 Opponents of surface mining contend that the technology is not available to provide for the adequate reclamation of lands following mining. Much of

their effort to ban such mining has been based on that contention.

{9} Hollis Dole, Assistant Secretary for Mineral Resources of the Department of Interior discussed at some length the means available to counter adverse environmental effects of both surface and underground mining. "Reclamation of mined areas," he said, "not only reduces pollution, but returns land to subsequent productive use."

9 Dole further stated:

9 The growing conviction that environmental damage caused by mining operations can be controlled and minimized through adequate safeguards and proper surveillance has led in recent years to the formulation of new environmental protection measures by several Federal Agencies having land management responsibilities. Mineral operations on these lands now must be conducted in accordance with the best available practices, and the lands disturbed reclaimed to a condition compatible with current standards.

9 Interestingly, the witness who followed Dole was John Quarles of the Environmental Protection Agency who said:

9 We do not have adequate technology to deal with all of the environmental problems that are created by mining and mineral processing activities.

9 A. T. Wright of the Wilderness Society stated:

9 . . . reclamation is at best a myth and at worst a hoax if we delude ourselves into believing that we can re-establish anything but a shaky monoculture on strip mined areas.

9 It seems fair to state that the prompt restoration of surface mined land to its original natural state is impossible. The restoration of the same land to some useful state is more likely and in some situations could make the mined land more valuable. Representatives of both the coal and stone industries testified that the use of surface mined land after mining should be left to the decision of the operator-owner, or local government. Thus, they oppose Federal statutory language requiring restoration of mined land to the original contour, or the filling of all cuts.

9 Federal or State administration

9 The 1971 hearings revealed a significant change in the position of the mining industry from that expressed in the 1968 hearings.

9 On page 97 of the printed hearings on "Surface Mining Reclamation", 90th Congress, 2nd Session, Mr. Joseph Abdnor, representing the American Mining Congress testified:

9 Based on the mining industry's awareness of the economic factors involved, its experience in the diversity of the problem and engineering techniques of land restoration, and its analysis of the problem on a national basis, the American Mining Congress is opposed to the legislation before you today.

9 He further noted on page 98 of the 1968 hearings:

9 We do not believe Federal legislation is called for; we oppose it as unnecessary, undesirable, and impractical.

9 It is unnecessary because no plausible case exists for global Federal regulation producing a conflict of jurisdiction over the myriad local conditions which apply to the reclamation of surface-mined lands.

9 In the 1971 hearings, Abdnor once again represented the American Mining Congress. His recent testimony illustrates the change in the mining industry's approach:

9 Let me say at the outset that the American Mining Congress endorses the concept embodied in a number of the legislative proposals pending before this Committee - namely, that it is appropriate for the federal government to have and exercise the authority to establish guidelines for the regulation of surface mining. While urging that the states have a responsible role, we recognize that when federal guidelines are thus set, it is incumbent on a state to satisfy those federal guidelines; and if it does not, then the federal government will come into a state and do the job itself.

{10} In 1968, conservationists found acceptable the proposition of Federal guidelines for the States to use in the development and administration of their own programs - the approach now supported by a large segment of the mining industry.

10 The conservationist position has also undergone a shift. Based on their observations of State programs to regulate surface mining and reclamation, conservaionists find State control unsatisfactory, in many instances. As a result, their request is now for a Federally administered program.

10 Assistant EPA Administrator John Quarles criticized the existing situation, noting:

10 Many of the State statutes are inadequate and ambiguous; some do not admit of equitable enforcement. State enforcement has been hampered by lack of funds and personnel. In addition, most of the State laws . . . are too limited in coverage to provide a comprehensive remedy for the problem.

10 United Mine Workers of America representative Joseph Brennan, speaking in support of S. 2777, said:

10 S. 2777 contains a provision for State control over stripping under certain circumscribed conditions. We have some misgivings on this section because of many State failures in the past to adequately control stripping or to effectively enforce proper statutes.

10 Other critics of the State programs were more outspoken. Peter Borrelli of the Sierra Club testified:

10 There are two basic reasons for the failure of regulation. One is lack of enforcement. The feeble regulatory efforts of West Virginia and Kentucky are just no match for the immense political and economic power of the coal industry. . . . Pennsylvania can at least balance the scale with some real enforcement, but blatant violations of the law abound.

10 The second reason for the failure of regulation is that regulations in all three states prescribe procedures to be followed, rather than results to be achieved.

10 Norman R. Williams, former official in the West Virginia surface mining regulatory program concluded, "the surface mining industry in Appalachia is not amenable to social control". He charged that in West Virginia:

10 . . . the entire regulatory apparatus of the State is geared to protect the surface mine operator's profits as against protecting the environment and downstream residents.

10 In contrast, two active State reclamation officials, William Guckert of Pennsylvania and Sanford Carby of Georgia testified in support of an overall Federal program but for a State role. Guckert, for instance called for Federal legislation which "should set the standards, requirements and penalties, but the responsibility for enforcement should be with the individual States".

10 S. James Campbell of the National Crushed Stone Association cited the historic role of State and local government in determining land use patterns.

He said:

10 Blanket federal rules respecting reclamation would conflict with and undermine efforts of state and local authority to provide rational growth and land development.

{11} Administering Federal agency

11 There was a strong difference of opinion apparent in the hearings as to which agency should lead the Federal effort in establishing guidelines and administering the program.

11 Department of Interior Assistant Secretary Hollis Dole testified:

11 The Department of the Interior, whose function is the formulation and administration of programs relating to management, conservation, and development of our natural resources, is the logical agency to administer the proposed act.

11 His position was supported by industry spokesmen and others who acknowledged the expertise of the Department of the Interior.

11 Carl Bagge stated that Interior was best qualified to administer the Federal program, particularly in light of the fact that, "the Mining and Minerals Policy Act of 1970 charges the Secretary of Interior with the responsibility of carrying out the policy of that Act".

11 Joseph Brennan testified for the United Mine Workers that, "the Department of Interior is the logical place for enforcement . . . ". He added:

11 On the other hand, there is a great deal of knowledge about the impact of strip mining and the damage done to the environment by strip mining outside the Department of Interior. To bring this knowledge to the fore, S. 2777 provides for the use . . . of experts from other governmental agencies. It also establishes a strip mining advisory commission, with membership appointed by three somewhat diverse governmental departments.

11 The Secretary of Interior would appoint three members . . .

11 The Secretary of Agriculture would appoint three members . . .

11 Finally, the responsibility for the Federal anti-pollution law rests with the Administrator of the Environmental Protection Agency . . . [who would also appoint three members of the advisory commission].

11 In general, conservation and environmental groups favored vesting primary Federal authority in the Environmental Protection Agency.

11 Malcomb Baldwin, testifying for the Conservation Foundation, said:

11 We believe that the Environmental Protection Agency, which is responsible for enforcing most of the nation's Federal environmental protection laws, is in the best position to enforce strip mine legislation. This separation of enforcement duties from the Department of the Interior's development and management functions is consistent with the theory behind the Administration's environmental reorganization proposals. Conflicts of interest historically apparent within the Department of the Interior can be resolved by giving EPA enforcement authority over coal strip mining.

11 Among others sharing this position were the Black Mesa Defense Fund, and the Sierra Club. Senators Cooper and Baker advocated EPA as the lead agency for the Federal effort. Senator Cooper noted:

11 Senator Baker and I have concluded that the proper agency for control would be the Environmental Protection Agency, cooperating with the Department of the Interior's Bureau of Mines, and with the Forest Service and Soil Conservation Service of the Department of Agriculture, and others.

11 The case for the Department of Agriculture as lead agency was made by David Unger, of the National Association of Conservation Districts:

11 The Federal responsibility for dealing with the impacts of mining on the land surface should be exercised by the Department of Agriculture. USDA is the recognized authority in dealing with erosin, land reclamation, and land conservation. Working in cooperation with our conservation districts, the Department has built up a network of technical, financial, and educational arrangements which are already being utilized in mined-land reclamation and which would be available for an accelerated and expanded program.

{12} Virtually all of the research being conducted on reclamation of mined lands is being done by USDA and cooperating Agricultural Experiment Stations. . . .

12 The Soil Conservation Service of the Department of Agriculture has nearly 40 years of experience in the scientific planning of land reclamation and conservation work . . .

12 SCS has available a corps of nearly 8,000 trained technicians across the country who are experienced in the application of technology to land problems of this kind.

12 Additional issues

12 Several points, not previously discussed in this Committee Print, appeared in the hearings a number of times. These are the special characteristics of some mineral operations; the problem of previously mined lands including questions of ownership; a severance tax on surface mined minerals; a timetable for the implementation of surface mining regulation; and other suggested additions or deletions with regard to the then pending legislation. The contentions on these points are outlined in the following sections.

12 Special characteristics of some mineral operations

12 Rather broad support was made for the point that surface mining for different minerals creates different problems - and that any Federal reclamation law should recognize those differences.

12 Malcomb Baldwin of the Conservation Foundation said:

12 However, many of the bills now being considered would legislate for all forms of surface mining. We believe these bills to be inadequate, because they do not recognize the problems peculiar to each form of strip mining.

12 Georgia reclamation official, Sanford Darby, noted:

12 I know from experience in writing the Georgia rules and from administering and enforcing the provisions of this law many of the problems involved. I can assure you that if you delegate complete responsibility to the Secretary of the Interior or to any one specific government official the responsibility of developing regulations which will apply to the entire United States, he is going to have an almost impossible task to accomplish.

12 S. James Campbell, of the National Crushed Stone Association, said:

12 With regard to the requirements of several of the bills this Committee is now considering, I would call to your attention the unique character of our industry. Quarries have to be located in or near urban areas because of the high cost of transporting heavy stone materials. Consequently, our industry is already subject to heavy local regulation through zoning and area growth plans. Again, a quarrying operation disturbs very little land - the average quarry encompasses less than 30 acres. Because almost 85% of the materials excavated from a quarry is sold, there is virtually nothing left for land fill. Moreover, typical types of quarries have a life expectancy of about 81 years.

12 With the exception of being located near urban centers, these same arguments are also applicable to the mining of iron ore. Tom Binger said of his company's experience in Minnesota:

12 It is the numerous inactive mines and lean ore stockpiles that can be relied upon to provide the demands of the increased steel production in times of national emergency. If all the pits in Minnesota had been "reclaimed" and the lean ore piles dumped back in the open pits, I do not believe the production requirements of World War II or the Korean War could have been so easily fulfilled.

12 . . . My company's operations have always involved the adoption of new techniques to gain mineral values from mines that have thought to have been exhausted of economic ore by a previous operator. Had the previous operator contaminated the mine by the reintroduction of surface materials or had he not carefully segregated the lean ore materials brought to the surface in his operations, it seems certain to me that most of the iron ore we have been able to produce would not have been possible.

{13} Previously mined lands

13 There are about two million acres of land which have been disturbed by surface mining but never reclaimed. Provisions for treatment of these "orphan lands" are included in some - but not all - of the pending bills.

13 Senator Clifford Hansen said of S. 1160, which he introduced:

13 The Subcommittee has devoted much time and effort to several bills pending in the Congress concerning strip mining and underground mining and the restoration and reclamation of mined lands. I am deeply concerned however, that these bills do not provide for restoration and rehabilitation of areas which have been mined in the past and have been long since abandoned.

13 The bill would provide nationwide application of a program presently limited to Appalachia whereby the Secretary of Interior makes grants to seal and fill voids in abandoned coal mines. Abandoned oil and gas wells would also be covered by S. 1160.

13 Assistant Interior Secretary Dole testified in opposition:

13 * * * preventing the annual additions of new problems is relatively more important than initiating broad new programs to ameliorate the affected lands of the past. We must bring under control today's and tomorrow's potential damages

to the environment before we can make reasonable headway against those of yesterday.

13 * * * Our second reservation concerning S. 1160 is centered quite simply on the basis of cost. It is truly a very substantial expense which will be involved in repairing past mining damages. It is not one that can be imposed readily on its perpetrators, as too many of the former mine operators and landowners no longer control or own the mined property. And because our knowledge of what really needs to be done is incomplete, the potential for costly mistakes is large.

13 Senator Jennings Randolph testified that in West Virginia:

13 The principal remaining concern is acid mine drainage from abandoned and orphaned surface mined lands.

13 The Conservation Foundation, referring to coal, stated.:

13 We recommend a joint State-Federal program, in which initially the states should catalogue and establish reclamation plans and priorities for these lands and the Federal government should provide the funds and special expertise. Then the states and/or the Federal government should proceed selectively to reclaim or rehabilitate.

13 We recognize that there are problems of windfall profits to private owners benefitting from the enhanced value of their lands. However, liens could be applied by states, to assure that an owner of reclaimed land would repay the state for any increment in value resulting from reclamation, at least up to and including the resulting increment in fair market value of the land.We recommend that new legislation require a thorough study of the "revolving fund" mechanism whereby public acquisition and resale of subsequently reclaimed land can fund the purchase of more such land.

13 Severance tax on surface mined minerals

13 Senator Howard Baker testified:

13 We should consider the establishment of a severance tax on all coal and on other fuels at the Federal level to insure uniformity and make the proceeds thereof available to the states or locality if they elect so that the benefits of this resource can accrue to the area in which it is located.

13 In later questioning, he indicated that he would make such a tax applicable to all surface mined minerals, not only fuels.

13 Norman Williams also supported a tax on coal to facilitate reclamation:

{14} * * * a Reclamation Trust Fund should be established, based on a per-ton tax of all coal mined, the money to be devoted exclusively to purchasing and restoring lands inadequately reclaimed from surface mining or deep mining of coal, and also for funding workshops and other organized efforts to train citizens in monitoring techniques.

14 Peter Borrelli, of the Sierra Club, offered as one method by which the "federal government might affect partial prohibition" of surface mining of coal:

14 A tax of $2 .50 per ton, on strip-mined coal to remove the competitive advantage of strip mining over deep mining. The tax could be used for federally administered reclamation.

14 A timetable for surface mining regulation

14 The administration surface mining proposal allows two years for the States to develop requirements for mining operations and reclamation. Another proposal, S. 1498, would abolish surface mining for coal within six months of enactment. The timing of controls for surface mining thus remains an active question.

14 Administration spokesmen defended the two year time allowance to the States on the grounds that some State legislatures met only every two years, and thus would need the time allowed by the administration proposal.

14 Senator John Sherman Cooper proposed a more compressed schedule:

14 This procedure, establishing a system of primary State regulations, backed up if necessary and enforced by the EPA, would require 16 or 18 months to develop - 6 months from enactment for the EPA to issue comprehensive guidelines and criteria to the States, 6 months for the State to develop its plan based upon the Federal criteria and guidelines, and then 4 to 6 months for the action of the EPA in approving or amending State plans.

14 Noting the problems that unregulated mining could cause during even the 18 month period, Senator Cooper added:

14 I therefore propose that during this interim period, surface mining be conducted only under Federal authority, with the approval of the EPA.

14 Our proposal would establish an interim Federal program, under Federal authority of the Environmental Protection Administration. Any person currently operating a surface mine, or proposing to initiate operations at a new site,

would be required to file a plan with the EPA describing the method of operation and the restoration program. The Administrator of EPA would have to approve the plan if the operator is to continue operations, or initiate new operations. The Administrator would approve the plan only if he were assured that restoration is adequately provided for. Six months after enactment no person could operate a surface mine except in compliance with the interim Federal controls and EPA approval.

14 A similarly compressed timetable was proposed by Baldwin of the Conservation Foundation, who said:

14 * * * we recommend that Federal law should give the states a regulatory role, but that it should allow them not more than six months to develop Federally-approved laws, regulations, and implementation procedures. Failing such approval, Federal standards and enforcement should apply.

14 Given the general condition of state law and the urgency of radical changes, it may well be that the foregoing propsal might result in direct Federal control over coal strip mining in many states, through Federal permits, regulations, and inspection programs. Such a direct Federal role would find some precedent in Federal enforcement of the Coal Mine Health and Safety Law.

14 As part of the Federal program, Baldwin also recommended that, "all contour stripping cease within six months of the date of enactment of the Act."

{15} Other proposed additions and deletions

15 The hearings elicited numerous suggestions as to additions, deletions and changes in language of the several bills. Several witnesses, such as HELP and the League of Women Voters of Scranton, Pennsylvania, and the National Coal Association provided detailed reviews of the pending legislation.

15 Among the suggestions offered were these:

15 The American Mining Congress expressed concern that any legislation approved by the Committee, "include an appeals procedure, including the right to judicial review by the courts". The Mining Congress also declared, "that criminal sanctions in a federal surface mining statute would be most inappropriate".

15 The National Coal Association said that, with regard to any federal guidelines, or regulations, "public notice and the right to comment should be required".

15 The deletion of control of underground mining was proposed by E. R. Phelps, President of Peabody Coal Company, who said:

15 The coal industry believes the legislation should not include the environmental regulation of underground mining.

15 R. W. Hatch added in this regard:

15 * * * no practical technology has yet been developed to control subsidence in underground coal mining, so there is no way that that part of the statute could be enforced.

15 The Crushed Stone Association offered this suggestion:

15 We propose that such legislation define the term "reclamation" to specify that flexible land reuse is the will of Congress. The failure to make this clear will, we submit, invite "guidelines" ordering a return to as near original condition as possible irrespective of possible alternative uses that would result in a higher use of such land.

15 The Association also offered a suggestion that was repeated by other mineral industry witnesses:

15 That any Federal guidelines or state standards should be required to be consonant with the Mining and Minerals Policy Act of 1970.

15 These are, of course, but a few of the many suggestions offered during three full days of testimony. The selection is not meant to be encyclopedic, but only to provide an indication of the concerns expressed. While it is hoped that this review of the hearings is balanced, overall, the full hearing record must be examined as the final source on what transpired.

INTRODUCTION

TABLE 1. - COMPARISON OF SELECTED PROVISIONS OF 92D CONGRESS BILLS TO REGULATE SURFACE MINING

Bill No.	Sponsor	Lands, affected minerals	State-Federal relationship agency involved	Bond required	Source of funding
			1. Establishes		

a national
advisory
committee.
2.
Secretary of 1.
Agriculture Establishes
and Interior "Mined Lands
develop Reclamation
Federal Revolving
standards Fund" from
and issuing (a)
mining appropriatio
permits ns, (b) sale
and/or 3. or lease of
Approve Federal
All lands, State lands, (c)
all standards fines and
minerals, and forfeitures,
S-77, surface only requirements (d) other
introduced Nelson, retroactive as effective operation
Jan. 25, Percy, and future as Federal sources of
1971. Stevenson mining. standards. money.
1. State
plan 1.
submitted to Establishes
Secretary of Mined Lands
Interior for Reclamation
approval Fund from
within 2 (a)
years. 2. appropriatio
If not, ns, (b)
Secretary permit fees,
issues (c) other
regulations charges and
and permits penalties.
All lands, for 2. Federal
all particular cost of
S-630, minerals, States/or State
introduced surface grant a 1 Program, not
Feb. 5, 1971, only, future year to exceed 50
H.R. 60. Jackson mining only extension. None percent.
1. State
plan
submitted to
Secretary of
Interior for

			approval within 2 years. 2. If not, Secretary issues regulations and permits		
S-993, S-1176, introduced Mar. 10, 1971, H.R. 4704, 4967. 5689, 6580, 7422,	Administration bill: Jackson, Allott, Cooper, Case.	All lands (except Federal and Indian) all solid minerals, surface and subsurface future mining only.	for particular States/or grant a 1 year extension. 3. Establishes an advisory committee.	None	1. Appropriations authorizing Federal Government to finance 80 percent of State 1st year cost.
S-1498, introduced Apr. 5, 1971, H.R. 4556, 4557, 6484, 6485, 7675, 7695, 8174, 8386.	Nelson, M Govern, Kennedy, Humphrey, Case, Harris,	All land, coal only. Surface only except subsurface National Forests retroactive and prohibits future mining.	1. EPA promulgates regulations. 2. EPA to publish regulations for underground coal mines after which States submit implemention plans for approval. 3. If not, EPA sets forth implementati on plan for State. 4. Federal pays 90 percent of costs of acquisition and reclamation.	Bond for each mine.	1. Executive order empowering Federal assistance by agencies through grant, loan, or contract.
			1. Secretary of		

S-2455, introduced Aug. 5, 1971, amended Nov. 12, 1971.	Moss	All lands, all minerals, surface only retroactive and future mining.	Interior consulting with, EPA and Secretary of Agriculture to promulgate standards and/or; 2. Approve State standards comparable to Federal standards	within 180 days.	Bond amount to be determined by Secretary of Interior.	1. Establishes strip mining land restoration fund from (a) fees and fines (b) appropriations.
S-2727	Jackson, Allott	Federal only, all locatable minerals, surface and subsurface.	1. Administered by Department of Interior 2. Subject to all applicable State and Federal laws.		Bond, yes	1.Fines. 2. Rental fee. 3. Royalty fee.
			1. Establishes strip mining advisory commission. 2. Secretary of Interior shall develop and promulgate standards and/or; 3.Delegate authority to State to	Not less		1. Strip mine reclamation fund with funds from (a) appropriatio

All lands, enforce than ns (b) fines
all State law $1,000/acre and fees (c)
S-2777, minerals, consistent $10,000/ sale, lease,
introduced surface only with operation or rental of
Oct. 29, (H.R. 10758) retroactive provisions determined reclaimed
1971. Gravel and future. of act. by Interior. land.
1. EPA
administered
- promulgate
standards
within 4
months. 2.
State
submits plan
to EPA
within 8
months. 3.
Federal
Government
takes
control
durinterim
period. 4.
No surface
mining
without 1.
All lands, license 270 Appropriatio
Cooper- coal only, days after n. 2.
S-3000 Bennett surface only enactment. Yes Fines.
All lands, Secretary of
all Interior to
minerals, make grants
surface and on a
subsurface matching
S-1160, Mar. retroactive basis to Appropriatio
9, 1971 Hansen only. State. None ns.
Secretary
designates
Public lands those lands
designated on which
Church, L. by Secretary mechanical
Jordan, of Interior, equipment is
Mansfield, all minerals prohibited
Metcalf, surface in mining
S-1240 Moss. only. activity. do

SELECTED COMMENTS FROM THE HEARINGS

Bill No.	National Coal Association comment	U.M.W. comment	Environmental groups	Agency comment	Specialized mining industry comment
S-77, introduced Jan. 25, 1971.	Administration by 2 sections would result in confusion.		Not supporting (1) Joint control, (2) Government pays 75 percent of cost to rehabilitate land previously damaged.	Sand and gravel, iron ore, crushed stone, copper-open pit.	
S-630, introduced Feb. 5, 1971, H.R. 60.	Favors this approach, recommends that, (1) Public notice be required. (2) That all parties have the right to comment on regulations. (3) Advisory committee at Federal and State level.		Not supported, (1) encourages State regulations of surface mining only will Federal goal as backup.	None of proposed regulations. Appropriate to long-term operation, little spoil, no land fit.	
S-993, S-1176, introduced Mar. 10,	Favors this approach, recommends: (1) Right of operator to appeal to Department of Interior if State denies permit. (2) States be required to grant operator a hearing if		Sierra Club sees little improvement except marginal in	Will allow the necessary development of our mineral resources	

1971, H.R. his some States and insure
4704, 4967, operations not now protection
5689, 6580, are having of our
7422. prohibited. legislation. environment.
Unrealistic
and
irresponsible
reduced
S-1498, production 44
introduced percent and
Apr. 5, 1971, ignores the
H.R. 4556, fact that the
4557, 6484, technology
6485, 7675, for Sierra Club
7695, 8174, reclamation Against this supports Not
8306. has improved. approach generally supported.
Costly and no
advantage
mine
operators
would be
responsible
first to
S-2455, State, then LWV support Limited to
introduced Federal reclamation surface
Aug. 5, 1971, Government, provisions only. Not
amended Nov. then back to with broad
12, 1971. State. amendments. enough.
Full
support: (1)
Tight
Federal
control
should
satisfy
citizen
revolt
Attempt to against all
impose strip
uniform mining. (2)
standards Best
regardless of assurance
S-2777, existing that the LWV support
introduced conditions ecology will judicial
Oct. 29, would not be be review
1971. desirable. preserved. provision.

S-1160, Mar. 9, 1971	Would not regulate future mining limited to reclaiming mined lands.
S-1240	Too narrow limited to control of heavy equipment use on public lands.

[See Table in Original]

SELECTED READINGS:

GENERAL

THE SURFACE MINING ISSUE: A REASONED RESPONSE

29 (Efforts to abolish surface mining in West Virginia are now under way in the current session of the legislature. As must be expected, the surface mining industry opposes, categorically and unequivocally, any proposed legislation that seeks to put it out of business and place its employees on the rolls of the unemployed. The following is a statement issued by the West Virginia Surface Mine Association to inform all West Virginians, and indeed the Nation, the vital roll that surface mining plays in serving mankind in terms of economics, employment and energy needs.)

29 We in the industry know that surface mining is an emotional issue to many people. But we also know that emotionalism, unsupported by fact and sound judgment, creates more problems than it solves.For this reason, we are making every effort to respond objectively and logically to this unprecedented challenge to our industry's existence.

29 In the emotional fervor of environmental concern, we can understand how wellintentioned citizens - especially those who have had littel exposure to the positive values of surface mining - might be unduly influenced by overzealous critics of the industry. But this in no way changes the facts.

29 By any yardstick of reason, the proposal to outlaw surface mining can only be interpreted as ill-advised and unrealistic. It is unsound because it ignores the serious and damaging consequences to the economy of both West

Virginia and the nation. At best, it is an extremist solution to what is essentially an aesthetic problem.

29 INFLUENCE OF HISTORY

29 To better understand the facts at issue, it is essential to remember that the surface mining industry of today operates on a far more scientific and knowledgeable basis than it did 20 or 30 years ago.

29 Surface mining received its first major impetus during the national energy crisis of World War II. At that time the urgent demands of war overrode any immediate concern for restoring or reclaiming disturbed land. In those years the science of reclaiming mined land was still in its infancy. As a

result, land abuse was fairly common, and, unfortunately, a tradition was established that endured far too long.

29 But the fact that should be made clear here is that the mistakes and malpractices of the past are history, and only history. They bear no relationship whatever to the manner in which surface mining is conducted today.

29 RESPONSIBLE SURFACE MINING CAN BE DONE UNDER EXISTING LAW

29 In 1967, West Virginia enacted one of the most stringent surface mining and reclamation laws in the Nation. It not only prevents repetition of irresponsible practices but also makes provision for reclaiming the "orphaned banks" inherited from the past.

{30} Properly enforced, the existing law is fully adequate to protect our land and our heritage. What's more, it is enforceable, and it is being enforced. As a result, surface mining in West Virginia today not only can be but is being done responsibly - with prompt and full reclamation of all land disturbed in the process. In fact, since the passage of the 1967 law, we have been reclaiming more land than we mine. And given time, we will catch up to our history.

30 As surface mine operators, we take seriously our environmental obligations to the people of West Virginia. We fully support adherence to proper surface mining surface mining and reclamation law.

30 NATIONAL ENERGY CRISIS

30 Right now there is as serious a shortage of coal as this Nation has ever known. Those unaware of the severity of this crisis may complacently claim that

surface mining should be abolished. But it is extremely doubtful that the Nation could do without the energy derived from surface-mined coal.

30 Demand for electric power, for example, is expected to double by 1980, requiring twice the volume of coal being used today or 1.1 billion tons a year. Add to this another 150 million tons for conversion to gas and other uses, and we have a demand 12% greater than today.

30 A ban on surface mining would shrink coal supplies to a catastrophic degree and force prices to rise even higher. At home this would mean severe power shortages and higher costs to the consumer at a time when we are all concerned about inflation. It would also indirectly jeopardize the country's coal exports at a time every effort is being made to improve our balance of trade.

30 These are some of the national implications that a ban on surface-mined coal would have. The direct consequences to the economy of West Virginia would be even more drastic. Let's look at some of them.

30 LOSS OF 26.9 MILLION TONS OF COAL PRODUCTION

30 In 1970 West Virginia produced 26,987,598 tons of surface-mined coal with a total market value of more than $1 88 million. Production and distribution statistics of surface-mined coal for the years 1968, 1969 and 1970 are given in Table I.

30 If shipped at one time, this much coal would require a train of 359,835 coal cars, stretching out over 3,067 mi - or almost the distance from Miami, Fla., to San Francisco, Calif.

30 This same quantity of coal could provide a city of 80,000 population, consisting of 24,000 family units, with enough electrical power to last 580 yr. This projection applies to residential use only, Nevertheless, even if business and industrial power usage were added, this much coal would still furnish power to a city of this size for 104 yr.

30 Should surface mining be abolished, it is improbable that this production loss could be made up entirely by deep mining methods. A surface mine is twice as productive as a deep mine, requires far less capital investment, and can be placed into production quickly. By comparison, a minimum of 3 to 4 yr would be needed to develop the number of deep mines that would be required to produce this vast amount of coal. Moreover, surface mining recovers deposits of coal that cannot be mined any other way.For the most part, this coal is found near the outcrop of the mountains and other areas where rock strata is too weak to

support a safe roof for deep mining.

TABLE I - SURFACE MINE COAL PRODUCTION AND DISTRIBUTION STATISTICS

	1968	1969	1970 n1
Employees	3,460	3,651	5,571
Production (tons)	16,703,461	18,867,500	26,987,598
Shipped by: n2			
Rail (tons)	13,211,214	14,496,070	20,729,380
Truck (tons)	2,189,448	2,675,524	3,825,999
Barge (tons)	1,102,947	1,501,556	2,047,224

30 n1 1970 production figure is actual; other figures are projected.

30 n2 Excludes local trade and stocked.

TABLE II. - RECAPITULATION OF ECONOMIC CONTRIBUTION TO WEST VIRGINIA BY
SURFACE MINING AND DIRECTLY RELATED INDUSTRIES FOR 1968

Industrial contributor	Number of employees	Wages	Taxes (other than Federal corporate income taxes)	Supplies and services	Total contribution
Surface mines	3,460	$20,392,000	$3,111,000	$32,505,000	$56,008,000
Railroads	549	4,755,000	417,000	677,000	5,848,000
Barge lines	46	379,000	6,000	712,000	1,096,000
Trucking	91	901,000	131,000	662,000	1,694,000
Equipment manufacturers	16	95,000	7,000	25,000	126,000
Total	4,162	26,522,000	3,672,000	34,581,000	64,772,000

31 Source: National Coal Association study dated July 14, 1970.

TABLE III. - 1970 PROJECTIONS n1 OF STATISTICS IN TABLE II RECAPITULATION OF ECONOMIC
CONTRIBUTION BY SURFACE MINING AND DIRECTLY RELATED INDUSTRIES TO WEST VIRGINIA

Industrial contributor	Number of employees	Wages	Taxes (other than Federal corporate income taxes)	Supplies and services	Total contribution
Surface mines	5,571	$32,831,120	$5,008,710	$52,333,050	$90,172,880
Railroads	884	7,655,550	671,370	1,089,970	9,415,280
Barge lines	74	610,190	9,660	1,146,320	1,764,560
Trucking	147	1,450,610	210,910	1,065,820	2,727,340

Equipment manufacturers	26	152,950	11,270	40,250	202,860
Total	6,702	42,700,420	5,911,920	55,675,410	104,282,920

31 n1 Projections made by applying a growth factor of 1.61 to 1968 statistics given in table II.

31 ECONOMIC IMPACT OF SURFACE MINING TO WEST VIRGINIA'S ECONOMY

31 On July 14, 1970, the National Coal Association, Washington, D.C., released an in-depth study of the impact made during 1968 on the economy of West Virginia by the surface mining, coal hauling and mine equipment industries.

31 While documented statistics for 1970 are not now available, we have been able to project current impact by applying a growth factor of 1.61 to the 1968 figures. This growth factor is determined from the increase in surface-mined coal tonnage for the year 1970 (26.9 million tons) over 1968 (16.7 million tons). If anything, such projections will be conservative since wages and the cost of supplies and services have risen considerably in the past 2 yr.

31 A tabulation of the NCA statistics for 1968 is given in Table II and projections for 1970, in Table III.

31 $104 MILLION IN WAGES, TAXES, SERVICES AND SUPPLIES

31 Projections for 1970 based on the 1968 study show that the mining and transportation of surface-mined coal and the manufacture of mining equipment created 6,702 jobs with a total annual payroll of $42.7 million and contributed to the economy a total of $5 .9 million in taxes (business and occupation tax, workmen's compensation, county property, and corporate net income), as well as expenditures of $5 5.6 million in supplies and services, including gasoline, oil, repairs and purchases of equipment. Total projected contribution to the economy from surface mining and directly related industries comes to a total of $104 million for 1970.

31 The projected breakdown for the surface mining industry, alone, shows that 5,571 jobs were created (including production workers, supervisors, and on-site office workers) with an annual payroll of $32 2,831,120. In addition, an estimated $5,008,710 were paid in taxes and $5 2,333,050 expended for services and supplies. The 1969 statistics for surface mine tonnage and employees, by county, are given in Table IV.

TABLE IV. - 1969 STATISTICS FOR SURFACE MINE TONNAGE AND EMPLOYEES, BY COUNTY

	Production tons	Number of employees
Barbour	1,576,927	196
Boone	2,202,078	317
Brooke	212,807	41
Fayette	1,492,436	210
Gilmer	51,445	15
Grant	502,131	111
Gr eenbrier	6,875	5
Hancock	3,217	4
Harrison	900,747	170
Kanawha	1,855,381	369
Lewis	519,326	144
Logan	1,411,324	252
Marion	110,460	22
McDowell	1,411,826	262
Mercer	207,321	41
Mineral	80,167	14
Mingo	285,623	104
Monongalia	386,695	71
Nicholas	450,424	174
Preston	1,207,498	189
Raleigh	1,906,059	572
Randolph	78,510	47
Taylor	129,239	30
Tucker	570,052	79
Upshur	216,426	35
Webster	35,630	25
Wyoming	1,056,856	152

32 Source: 1969 Directory of Mines, State of West Virginia Department of Mines.

32 $128 MILLION IMPACT ON NON-RELATED BUSINESSES

32 Beyond this direct contribution to the economy by the surface mining, coal hauling and mine equipment industries, there is a second cycle of monetary expansion among non-related businesses.

32 Economists have determined that to measure accurately the effect wages have on the economy, the wages should be multiplied some three times, as every dollar spent will generate three other dollars in trade as it circulates through commerical channels. (It should be noted that a multiplier of three is very conservative. In many areas a factor of five or seven is commonly used.)

32 In 1970, the annual payroll for surface mining and directly related industries is estimated at $4 2.7 million. Using a multiplier of three, this means that another $1 28.1 million of business will be generated in year-round purchases of consumer items, such as food, clothing, housing, automobiles and other items. It also means that local businessmen, in turn, must hire clerks, salesmen, and other employees to satisfy the demands generated by surface mining and directly related payrolls.

32 With these facts at hand, a crystal ball is not needed to realize that economic losses to West Virginia would be staggering if the surface mining industry were abolished. Even more frightening is what a surface mining ban would do to the people of West Virginia who depend upon the industry for their support.

32 LOSS OF 6,702 JOBS

32 Should the forces seeking to ban surface mining in West Virginia succeed, an estimated 6,702 men would be forced out of work. The figures, by industry, break down as follows:

32 Surfacing mining, 5,571

32 Railroads, 884

32 Barge lines, 74

32 Trucking, 147

32 Mining equipment, * 26

32 * This estimate is extremely low. A recent check with five of the largest equipment suppliers in West Virginia showed that 401 jobs would be lost in those firms by the abolition of surface mining.

32 Most of these men have families. Based on 1960 Census figures, the average family in West Virginia consists of 3.51 people. This means that over 23,500 people in the state of West Virginia depend exclusively upon surface mining for their livelihoods. What will happen to these men and their families if surfacing mining is abolished? Some, undoubtedly, could be absorbed by other local industry at lower wages, But in areas where the unemployment rate is already high, many would be forced to go on welfare.

32 Another factor of no small concern is what happens to the surface mine operator if the industry is put out of business. Some of the larger operators

might be able to survive by taking their equipment to another state and try to start over. But others could well be forced into bankruptcy.

{33} LOSS OF $5.9 MILLION IN TAX REVENUE

33 If surface mining were abolished, the state of West Virginia would lose an estimated $5 ,911,920 in tax revenues. This is direct loss from the business and occupation, workmen's compensation, county property and corporate net income taxes. Additional tax revenues would be lost in the form of local or state sales taxes and diminished taxes from other businesses affected by the abolition of the surface mining industry.

33 TOTAL LOSS WOULD EXCEED $232 MILLION

33 When the $1 04.2 million direct contribution of the surface mining and directly related industries is added to the additional $1 28.1 million of business generated in nonrelated consumer industries, total loss to West Virginia's economy would exceed $232 million.

33 It is inconceivable to those of us in the industry that the state of West Virginia would be willing to sacrifice economic considerations of this magnitude for the sake of resolving an aesthetic problem. And except for the highwall that remains after land has been surfaced mined, the aesthetic problem is being resolved through effective reclamation practices.

33 The surface mining industry, as it evolved, has faced many difficult problems. But we have done, and are doing, much to solve them. As surface mine operators, we have two responsible jobs to perform: to supply the Nation with its demand for more coal and to return surface-mined land to beneficial use. We intend to do both jobs well. But we will need the help of the legislature and all clear-thinking citizens in the state to defeat the move to abolish our industry.

33 [From the Coal Age, June 1971]

SELECTED READINSG:

GENERAL

CRASH CAMPAIGN - TELEVISION COMMERCIALS HELP DEFEAT SURFACE MINE ABOLITION PUSH IN W.VA.

33 (Roy Alexander, president The Alexander Co. New York Public Relations Firm)

33 Just after Christmas 1970, West Virginia's Secretary of State, John D.

(Jay) Rockefeller IV announced a campaign to ban the surface mining of coal "completely and forever" throughout the Mountain State.

33 Key West Virginia lawmakers pledged their support when the legislature convened in late January, 1971. The state s most influential politicians jumped on the popular ecological bandwagon.

33 Influential newspapers - most notably, The Charleston Gazette - backed Jay Rockefeller completely. Letters poured in praising Rockefeller.

33 By early February, the juggernaut was rolling.

33 The futuure for surface mining in West Virginia looked bleak.

33 Yet 2 months later, the tide had turned. The Rockefeller forces found it hard to get legislative support. People started writing legislators asking them to vote against surface mine abolition. Protesting throngs marched on the state capitol. Pro-industry letters inundated newspapers. Citizen groups rose up to defend surface mining as necessary to bread and board. Rockefeller back-pedaled, calling for a "gradual phase out" instead of complete abolition.

33 When the legislature adjourned in March, 1971, it had passed a bill limiting surface mining growth in non-mining counties. And it imposed stricter reclamation rules (which the industry agreed to).

33 But the massive abolition movement had been soundly defeated.

33 What happened? The cutting edge was a series of television commercials. These commercials were rushed into production. They were on the air via eight West Virginia stations by early February. They influenced legislators directly and via voter-to-legislator impressions.

33 "In terms of sheer effectiveness - swaying undecideds, making out-and-out opponents think twice, getting our argument across - the commercials turned the tide in our favor," says O.V. (Dick) Vande Linde, executive director of the West Virginia Surface Mine Association.

33 How did this rush job come about?

{34} THE CRISIS MEETING

34 West Virginia Surface Mine Association, when formed in 1966, pledged itself to strong and enforceable reclamation laws and self-policing of members to enforce reclamation standards. And with more than 50% of its budget devoted

to reclamation research, the WVSMA was making orderly progress.

34 The association, however, was not equipped to take on enraged public opinion fostered by the Rockefeller campaign. The association started 1971 with no public relations or advertising budget. When Rockefeller lobbed his bombshell, WVSMA's Vande Linde sounded the toscin.

34 "We need a special assessment to fight this abolition movement," Vande Linde told members. "And we need it now."

34 But he was working with a small base. Only 25% of the state's surface mine operators are WVSMA members. A total of $5 0,000 over the association's regular budget was raised. This extremely modest budget would allow scattered newspaper advertising. But higher-priced television commercials - calling for production costs plus time costs - did not appear possible.

34 About that time Oak Leaf Coal Co. joined the association, and things began to change. In January, Robert D. Esseks, president of Sherwood Diversified Services - parent firm to Oak Leaf - attended a public relations action committee meeting held by WVSMA. Esseks immediately saw the need for dollar-stretching of association funds.

34 "Sherwood operates a commercial film division," he told the group. "We volunteer to produce television commercials and donate them to the association. With production costs out of the way, the Surface Mine Association could afford to buy TV time throughout the state."

34 The association committee - led by vigorous and vocal support of Don Streletzky of Bethlehem Steel and Hazlett Cochran of Consolidation Coal - was all systems go.

34 "We certainly appreciate it," association president Gil Frederick told Esseks.

34 The beleaguered industry was beginning to fight back.

34 MAKING THE COMMERCIALS

34 Oak Leaf Coal immediately engaged the services of a television film crew headed by John Nicholas. And Esseks assigned Sherwood's public relations firm - The Alexander Co. - to handle advance work for the film crew and manage the details.

34 That was Saturday.

34 On the following Monday, The Alexander Co.'s Bob Arnold arrived in West Virginia to advance the job. Using leads from Vande Linde, he talked to approximately 50 people throughout the state - seeking suitable candidates for filming.

34 "By this time, our strategy was clear," Arnold said. "We didn't want selfseeking industry members standing up before the camera pushing their viewpoint. We wanted a cross-section of people talking how the abolition of surface mining would affect their lifestyles and livelihood. And that's what we got."

34 Many volunteered. "My only problem was paring down the number of willing participants," Arnold relates.

34 By late Friday night, Arnold had set the film crew's itinerary. He had 19 persons ready for camera. Included among them were: a welder, two truck drivers, a service station owner, a restaurant owner, grocery store clerk, machine shop owner.

34 Helicopters from Hummingbird Air Service had been donated by Phil Nutter, also a surface mine operator and association member.

34 On Saturday morning the film crew went out in three helicopters. The fourman crew (camerman, sound man, director, and assistant) set up equipment, conducted an interview and then moved to another location in 20 to 30 min. The crew put 12 interviews on film that day.

34 Sunday, nature intervened.Snow. Helicopters were grounded.

34 To salvage the day, Vande Linde phoned Mrs. William Strange, president of a state-wide miners' wives protest group.

34 "Send them over to my house," she said. "I'll get people over here to be filmed."

34 When film crew director John Nicholas rang Mrs. Strangehs bell, at least 100 eager souls were waiting to talk about surface mining. By day-end, 19 subjects were in the can.

{35} CLOSING THE RING

35 On Monday (January 18) the film crew flew back to New York with raw film footage. Sherwood's editorial and optical houses started editing and finishing. Within a week, Sherwood's Esseks was presenting a reel of finished commercial tapes to the association public relations committee. WVSMA president Gil

Frederick gave the final green light.

35 Eight different commercials started appearing on West Virginia television the first week in February - less than three weeks after Oak Leaf had joined the association.

35 Citizens would turn on television sets and hear:

35 Jack Burdete. - "This thing makes me mad. They want to take my job away because I'm polluting. Heck, you can't raise a conversation in these hills let alone a crop."

35 Tipple operator J.L. Perkins. - "I've never followed politics much before. But when people start talking about taking my job away, it's a serious matter. I'm going to follow politics very seriously now."

35 Gus Glavaris, Logan restaurant owner. - "Almost everyone who eats in my restaurant is supported directly or indirectly by surface mining. Logan, W.Va., would wilt and die without the industry."

35 Further, material did double duty.Fahlgren & Associates, WVSMA's advertising agency, developed newspaper ads from the commercial material. Radio commercials were cut out of the TV sound tracks.

35 Reaction to commercials was swift. Government officials received irate letters. Miners protest groups converged en masse on Charleston to buttonhole legislators. As pressure increased, a legislator approached Vande Linde.

35 "We aren't going to pass an abolition bill," he said. "Your commercials are stirring people up too much."

35 He urged Vande Linde to halt the advertising campaign.

35 The campaign's success befuddled opponents. Some leveled wild charges. A letter in a Charleston newspaper questioned the ethics of the ad campaign. It suggested the industry - represented by a "big man in a big car, smoking a big cigar" - paid persons to appear on commercials.

35 "Far from it," says Esseks."If we had paid anybody, the commercials wouldn't have been as good. We approached the commercials in documentary style. Honesty and believability is the secret of successful viewpoint advertising."

35 PLANNING FOR FUTURE

35 What did it cost? Sherwood spent about $4 0,000 in fielding the crew, handling the advance work, and editing and finishing the commercials. The association spent another $40,000 in broadcast time and print space.

35 "For our part, we feel the funds were a good investment," Esseks said. "When a company happens to have a facility that can help its industry in a crisis - as we did with our film division - it should step forward and be counted."

35 Of course, winning a battle isn't winning the war - as WVSMA officials readily admit. Plans for next year are already underway.

35 "We know we've got a fight on our hands in 1972," Vande Linde said. "This time we want to start earlier and be better prepared. But this year, it was certainly vital to lay the facts on the public via television commercials. Since we couldn't have done it without volunteer help, we certainly give major credit to Oak Leaf Coal Co. and Sherwood this time around."

{36} [From Mining Congress Journal, September 1970]

36 "Whatever one may think of the logic of the nature or environmental moralists, their growing political muscle cannot be ignored by industry. And the extractive minerals industry is recognizing that . . . it is fighting for its domestic life"

36 Ecoethics, Environmental Politics and Miner-Devils

36 Adapted from a paper presented to the Annual Meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, at Denver, February 16, 1970.

36 By EARL COOK Associate Director and Professor of Geography and Geology College of Geosciences Texas A & M University

36 IN DISCUSSION, there is often a polite and tacit assumption of agreement on the meanings of terms like ethics, morality, sin and environmental quality. But there is substantial evidence that no general agreement exists on the precise meaning of any of these terms, and discussions based on an assumed agreement usually range from fruitless to divisive. In order, then, to stimulate useful discussion, or even to communicate ideas more or less accurately, I must start by giving my own operational definitions of ethics, morality, sin, and environmental quality.

36 An ethic is a cultural template that limits our freedom of action and

directs our efforts in the struggle for existence. Technology and our control of energy (including energy stored as money) tell us what we can do. An ethic tells us what we may do, among all the things we can do, and of the things we may do, which are better to do than others. An ethic describes or implies a set of cultural goals, as well as action modes for achieving those goals. The cultural goal of the Christian ethic is the establishment of the Kingdom of God on earth; the indicated action mode, however, depends on the means or strategy chosen to achieve that goal, and Christian action modes have ranged from ruthless conversion of the pagan and aggressive extermination of the infidel to kindly persuasion, meek example and hopeful prayer.

36 Morality is harmony between personal or group actions and a planned or prescribed strategy for reaching the cultural goals defined by an ethic; in other words, morality is a measure of ethical conduct. Often lost sight of, however, is the fact that morality is not measured in terms of the ethical goal but in terms of the action mode chosen to achieve that goal. Christians, for illustration, have found it much more difficult to agree on the appropriate means, in other words on what is moral, than on the desired end.

36 To facilitate the measurement of morality, codes of good and bad conduct are established by each group that espouses a particular strategy for reaching an ethical goal. The Ten Commandments, all codes of honor, and professional codes of ethics are conduct codes designed for easy measurement of morality. Perhaps because man loves to label and categorize his fellow man, such codes tend to acquire an importance that sometimes obscures the goals they were designed to advance.

36 In this operational context, sin is the commission of an action contrary to a conduct code. Although the subscriber to that code will assume that the sinful action is equally contrary to the ethical goal of his group, the outsider who sees another way of reaching that goal may not agree.

{37} Although a religious ethic was used to illustrate these definitions, the same principles apply to ethics and moral-conduct codes which attempt to deal with man's willful relations with his environment, in other words, which attempt to define ecoethics and environmental morality.

37 Except that the term so commonly is used without definition, it would seem unnecessary to say that environmental quality is an exceedingly fluid concept, meaning essentially "my external environment as rated or graded in terms of things I like and things I don't like." Only by health and hazard measurements can such environmental grading be made anything like uniform. Many, if not most, individual grades given to specific environments are ased on

complex mixes of health, esthetic, political, religious and even mystical criteria.

37 Aristotle saw ethics as branch of politics

37 Aristotle considered ethics a branch of politics, for, he said, "it is the duty of the politician to create for the citizen the best possible opportunity for living the good life," n1 and determination of the good life to Aristotle was a matter of ethics because it was a matter of determining cultural goals. He called the church the ethical arm of the state, and for hundreds of years of Western civilization the church was the ethical (and moral) arm of the state. During this time, the state or its prince had little difficulty in determining good (ethical goals), however much difficulty there might be in acting in accordance with that good (morality).

37 It was not until well along in the development of our present technological civilization that the church as the ethical arm of the state began to atrophy and to be variously replaced by military castes, "old school" alumni establishments, or by the leaders of new secular religions like communism and capitalism. For a time, each Western nation had one of these groups as either the official or unofficial ethical arm of the state. Then came the Great Depression which, with the dictatorships and wars that followed it, shattered the dream of universal affluence as well as the ideal of the perfectibility of man, and left Western man divided and doubtful about the old ethical systems.

37 n1 Chapter 2, Book One, The Ethics of Aristotle.

37 No ethical arm in modern nation

37 A modern nation has no ethical arm, although it will have ethically derived moral constraints built into its political-legal and social systems. Its political leaders move cautiously, trying to develop new devices for sensing what its people consider good and what they consider bad. They move cautiously because they face sustained and growing questioning of goals and values. They move cautiously because opinions differ and conflict, because many people are uncertain or unclear about their own values and goals. They move cautiously because values seem to be changing rapidly, especially among the young. And they move cautiously because there is great difficulty in determining what the people want, let alone what may create for them, in Aristotle's words, "the best possible opportunity for living the good life."

37 The difficulties of determining ethical attitudes of the public are well illustrated onthe environment scene. One can define such attitudes and study their historical development more easily than he can measure them.

37 Three identifiable ethical positions on environment

37 I identify three major ethical positions in today's discussions and controversies about environmental problems: the development ethic, the preservation ethic, and the equilibrium ethic. By the definitions I use, these are ethical positions because they imply cultural goals and state action modes or strategies for achieving those goals. Each of these ecoethics has its own appropriate code of conduct against which individual, political, or corporate morality may be measured. It hardly seems necessary to point out that an action which may be moral in terms of one ecoethic can be a sin in the context of one or both of the others.

37 Development ethic suggests action

37 The development ethic is the modern version of the dominion or conquest ethic, an important element of Judeo-Christian teleology which holds that man and nature are separate and that man has dominion over nature. n2 "Be fruitful and multiply," man was told (Genesis 1:28), "and fill the earth and subdue it; and have dominion over the fish of the sea and over the birds of the air and over every living thing that moves upon the earth." In this world view, good comes from the management and mastery of nature, and it comes from action, not from contemplation or from esthetic sensitivity.

37 n2 White, Lynn, Jr. "The historical roots of our ecological crisis," Science, v. 155, 1967.

37 The development ethic is reinforced by the work ethic which holds that work is good, and that any sort of non-work, except the rest needed to restore strength, is bad. Under the work ethic, contemplation is shunned, action is sought, continuous change is regarded as progress, bigger and faster are better, and economic and population growth are good.

37 The work ethic, which also finds Biblical sanction (II Thessalonians 3:10, "If anyone will not work, let him not eat"), got its great impetus from St. Benedict who taught that idleness is the enemy of the soul and who founded a great working order that at one time counted some 40,000 monasteries under its rule. The Puritans brought the work ethic to America: Cotton Mather denounced any "frolick" and proclaimed "what is not useful is vicious." The Puritan philosophy has dominated American business and was expressed very clearly by Henry Ford when he said, "I do not believe a man can ever leave his business. He ought to think of it by day and dream of it by night."

37 Release of human energy characterizes development ethic

37 The development (work-conquest) ethic is still the dominant template

controlling the release of human energy in America. In regard to nature it means that a dammed and diverted stream is good whereas a wild river is "lawless;" that any natural resource, once perceived, must be developed else the perceptor is unAmerican and probably sinful. The resource developer believes he is one of the vertebrae in the backbone of the country.He points with pride to the new capital he has produced, to the economic multiplier effects of his

activity, to the contribution he is making to regional economic health and to the national security.

{38} The pure conquest-of-nature ethic, once flaunted by Americans, is now, like the iceberg of simile, largely submerged. But the satisfaction of Americans in putting men on the Moon, and their willingness to pay for that "adventure in national pride," shows that it still exists. The dambuilder, the bridgebuilder, and the miner all feel the joy of conquest, as do the mountain climber and the astronaut. In regard to what is generally called "nature," however, it is dreadfully unfashionable to express. Eric Hoffer, the articulate retired longshoreman, is one of the few with the courage to be unfashionable in this regard; Hoffer combines a vigorous defense of man's "war with nature" with an aggression-displacement hypothesis: n3

38 n3 Hoffer, Eric. The Temper of Our Time, New York: Harper and Row, 1967.

38 ". . . the overcoming of nature, so crucial in the ascent of man, can be a most effective agency of humanization in the decades ahead - if for no other reason than that it may divert aggressive impulses and wild energies from social strife."

38 Preservation ethic has several frameworks

38 The preservation ethic forbids the further alteration by man of natural areas deemed to have special esthetic, recreational, scientific, therapeutic, or ecologic values. It may also require us to take steps to preserve an endangered vertebrate species other than man. Because this action (inaction?) mode fits several different ethical frames, I shall attempt to define the several ethical reasons for preservation in terms of hypothetical "pure" types of preservationist.

38 First, the mystic preservationist, who believes that nature is good in and of itself. If he doesn't actually regard man as bad, he certainly regards man's alterations of natural areas as bad, for he speaks of rape, desecration, and despoiling in describing roads, pipelines, dams, and mine dumps. He seems to prefer mountains and pines to plains and sagebrush, and he advocates

restricting the quantity (and in some cases, the quality) of visitors to preserved areas. The mystic preservationist may defend, as did St. Francis, another species' "right to existence." Nature mysticism in Judeo-Christian thought, long contrapuntal but subordinate to the nature-conquest theme, may have had its origins in religious retreats into the wilderness for spiritual renewal. n4

38 n4 Nash, Roderick. Wilderness and the American Mind, New Haven: Yale Univ. Press, 1967.

38 The nature-therapy preservationist believes that nature is not just good in itself, but that it is good for man, both physically and psychologically. He stresses a built-in genetic need of modern man to get close to and commune with nature, a need which has yet to be demonstrated except by the dogmatic declarations of its exponents.

38 [See Illustration in Original]

38 The esthetic preservationist also believes that certain natural areas are good for man, because of esthetic satisfactions which may be derived from visiting them. He would preserve an area because it's beautiful, not just because it's wild.

38 The scientific or curator preservationist wants to preserve examples of unusual or endangered species in their native habitat, to preserve diverse ecosystems in an undisturbed state, and even to preserve unique geologic formations from flooding or destruction because he feels man can learn more from natural than from captive individuals, from undisturbed than from altered systems, from natural variety than from humanized sameness. He may also believe that biological diversity strengthens the ecosystem on which man depends.

38 Significant as a political force is the recreation conservationist who wants natural areas preserved (but not pristine) so that he may hunt, fish, hike, picnic, or enjoy peace and quiet in them.

38 City dwellers supporters of preservation concept

38 The preservation ethic gets a great deal of its force from a reaction to crowded and unpleasant cities. Dislike of cities is old. Two thousand years ago, the Roman scholar Varro declared cities unnatural and corrupting, and Seneca described the evils of a civilization "too dependent on its machines, its energy-control devices and its creature comforts." These Romans envisioned a pastoral ideal, where the fertility of soils would be maintained by proper care and the guardians of the soil would be happy, virtuous men. Their good nature

was a man-made garden, not a wilderness.

{39} Some 1700 years later, the environmental pollution and urban stresses of the Industrial Revolution brought about a more violent reaction to cities; the garden or pastoral ideal was replaced with wild nature. For the first time, only about 200 years ago, mountains and forests became esthetically good. As late as 1770, Samuel Johnson had referred to mountains as "rather uncouth objects" and called the Alps "high and hideous." But to Rousseau, Wordsworth, Byron, Goethe, and other leaders of the Romantic movement, they were beautiful and good. They could serve not only as retreats from urban life, but as arenas of challenge where man unaided by machines could test himself against nature, and either renew his sense of fitness or end up in the English cemetery for fallen climbers at Zermatt.

39 In America, the anti-urban reaction was represented by men so different as Thomas Jefferson and Henry Thoreau. Jefferson believed that agriculture makes for individual character and national health and he wrote that "Those who labor in the earth [he didn't mean miners] are the chosen people of God . . . The mobs of great cities," he claimed, "add just so much to the support of pure government, as sores do to the strength of the human body." n5 Thoreau saw life of his time as a conflict between industrialism and simplicity, between the exploitation of nature and living in harmony with nature; he chose simplicity and harmony.

39 But most Americans accepted progress only in terms of rapid conquest and exploitation of the environment. In the America of the 1850's, a statement like this in a newspaper article surprised no one: "How great, how glorious is man, the conqueror of nature - and the immortal co-worker with God." n6 European emigrants came to America with visions not only of freedom, but of wealth.

They turned Jefferson's dream into a nightmare as they plowed and dug and cut and blasted and built their way across the Louisiana Purchase, which he had negotiated in order to keep America a nation of virtuous farmers.

39 n5 Quoted in Ekirch, Arthur A., Jr. Man and Nature in America, New York: Columbia Univ. Press, 1963.

39 n6 Quoted in Shepard, Paul. Man in the Landscape, New York: Alfred Knopf, 1967.

39 Conservation movement has seen shift in values

39 The westward crunch left behind in the northeastern United States a defeated landscape of deforested hills, depleted soils, rivers lined with

textile mills and iron works, and cities already crowded, dirty, and unhealthy. From this wreckage were to come both the forerunners and the leaders of the American conservation movement: James Fenimore Cooper, a novelist of the man-nature ethical struggle; Thoreau, Emerson, and the other transcendentalists; George Perkins Marsh, prophet of the ecological approach to balanced utilization; Francis Parkman, author of "The Oregon Trail" and mourner of a lost West; the Hudson River School of landscape artists; and finally, Gifford Pinchot and Theodore Roosevelt, who transformed an ecoethic into political reality.

39 The history of the American conservation movement is one of shifting ethical values, both inside and outside the group calling themselves conservationists. The closing of the American frontier marked the rise of the first phase of conservation. Moved by a fear of coming scarcity of natural resources on which the nation's "progress" and security depended, Pinchot, Theodore Roosevelt and others developed a conservation ethic that reflected enlightened self-interest and patriotic concern.

39 As defined by Pinchot, conservation was not an effort to achieve a balance with nature, but was an effort to attain the most efficient use of nature's resources in a manner that would assure each citizen "his fair share of benefit from those resources." There was, perhaps for the first time in a widely accepted nature ethic, a strong element of concern for posterity; Van Hise, one of the conservation leaders, wrote: "He who thinks not of himself primarily but of his race and of its future is the new patriot." n7

39 n7 Van Hise, Charles R. The Conservation of Natural Resources in the United States, New York: Macmillan, 1910.

39 Equilibrium ethic abandons growth-oriented economy

39 George Perkins Marsh, New England lawyer, author, and minor diplomat, was the first to recognize and document the longterm adverse effects of man's alterations of the environment and to advocate planning for ecological equilibrium. His book, called "Man and Nature," published in 1864, was so far ahead of its time that March might properly be called the grandfather, rather than the father, of the equilibrium ethic.

39 The equilibrium ethic would require us, on a global scale, to work towards achieving a stable equilibrium between man and his environment short of disaster. It implies ultimate stabilization of population and abandonment of a growth-oriented economy. Although we still seem a long way from widespread

belief in the necessity for such an equilibrium, the Environmental Quality Act of 1969 states that it should be public policy to "achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities."

39 Because the idea of any equilibrium in human population, in economics, or in resource use is so foreign to our growth-oriented society, adoption of this ethic as a frame for political decision will require a veritable revolution in human thought. George March was well aware of this more than a century ago when he wrote, "A political and moral reformation in the world is needed if technology is to aid conservation."

39 Aldo Leopold in 1949, at the close of the first 50 years of the American conservation movement, complained that "conservation as preached and practiced has only been enlightened self interest" and urged the development of a land ethic that would embody the concept of equilibrium between man and the land.

39 The modern equilibrium ethic took a long time to emerge, because it springs from the relatively recent awareness of man as part of a world ecosystem, and as a major perturber of that system in ways that produce unwanted and potentially lethal conseguences.

39 Although in recent years many voices have joined the equilibrium chorus, the nation's aspirations and economic planning remain rather firmly geared to growth. The equilibrium voices were all but drowned [See Illustration in Original] in the wails of the "undercounted" when the preliminary results of the 1970 U.S. Census were released!

40 Environmental politics growing greatly

40 Problems of the environment, whether they threaten man's health, impair his enjoyment, or offend his sensitivity, increasingly are being debated in the political arena and argued in the courts. "The status of the environment," writes Robert Cahn, member of the President's new Council on Environmental Quality, "is a major political issue." n8

40 n8 Cahn, Robert. "U.S. leaders light fires of concern for nature," C Christian Science Monitor, Jan. 27, 1970.

40 Time magazine suggests that "The environment may well be the gut issue that can unify a polarized nation in the 1970's." Senator Gaylord Nelson, who credits his own conservation activities with his distinction as the only Democrat in the 20th Century to be re-elected as Governor of Wisconsin, has called for a constitutional amendment stating that "every person has an inalienable right to a decent community."

40 Young people recently mounted a crusade for the environment, featuring a nationwide environmental teach-in on April 22. In California the Student

Environment Confederation will exert pressure on candidates in this year's state elections to run with environmental programs. More than 30 major environmental bills have been passed by Congress in the past four years and many more are in the hopper.

40 We have come a long way from the day in 1875 when President Grant, urged by his Army friends like Phil Sheridan who publicly advocated extermination of the buffalo as the best way to handle the Indian problem, vetoed the first measure ever passed by the U.S. Congress to protect a species of wildlife. We have come a long way from the day in 1902 when Uncle Joe Cannon, n9 the powerful Speaker of the House, asserted that Congress "was not going to appropriate one damned cent for scenery" and even from the day a few years ago when the late Robert S. Kerr of Oklahoma n10 on the Senate floor warned his colleagues to stop wasting time on "esthetics."

40 n9 Quoted in Diamond, Henry L. "The Politics of Beauty," Parks and Recreation, February 1966.

40 n10 Quoted in Frome, Michael. "The Politics of Conservation," Holiday Magazine, February 1967.

40 Burdens of proof shifting to developer

40 Most significant in all the controversy and discussion that swirls about questions of environmental pollution and degradation is the clear evidence of a burden-of-proof shift in the public attitude.

40 Up to now the initiative has been with the developer, the person proposing to modify the environment, and the burden of proof has been on the person who, objecting to the proposed alteration of the environment, has wanted to prevent or restrict it. In the political forum, the opponent has had to persuade decision makers that the cost to the nation of the proposed development would exceed its benefits. In the courts, he has had to demonstrate a clear and present physical or financial threat to himself in order to deter development.

40 Now both frames are changing. Extending the new philosophy of drug approval (that they be demonstrably beneficial) to the environment, many people now argue that the burden should be on the developer to prove that his proposal has a clearly positive benefit-cost ratio for the nation, in terms of environmental and ecological impacts as well as market values, before he should be permitted to alter the environment by building a dam, carving a highway, spraying pesticides, or tunneling into an ore body. Further, the courts have recognized the right of a citizen to maintain a suit on the grounds of esthetic

deterioration of the environment and have awarded damages for noise pollution by aircraft, unrelated either to direct overflight or physical damage, both of which used to be required to sustain such a suit. The courts have even been asked to define a Constitutional right to "an environment free of improvident pollution."

{41} [See Illustration in Original]

41 Shift enormously important to natural resource industries

41 The importance to a natural-resource industry of this burden-of-proof shift is enormous. With the burden of proof on the preservationist, for example, a virgin area may be deflowered (from his point of view) before he can arouse enough political support for annulment. With the burden of proof on the miner, however, an area of economic mineralization might lie untouched for years.

41 Movement of environmental problems into the political arena demonstrates an unwillingness any longer to let experts in the government make environmental decisions and an impatience with existing mechanisms for resolution of the problems. Consequently, we see more and more public confrontations on specific environmental issues, where the public attempts to bypass the experts in government and to deal directly with the industry involved, through political or legal action or both, and by a variety of mechanisms: through established conservation groups; by means of ad hoc task forces with names like Get Oil Out, Organization for an Unblemished Shoreline, and Group Against Smelter Pollution; through quasigovernmental environmental councils and advisory committees; and by establishing special-technique groups like the Environmental Defense Fund and student groups for public awakening like the Nature Conspiracy.

41 Tendency is for people to create straw devils

41 Many people appear to require a focus of indignation before they can incite themselves to political action. We will work hard to prevent a bad man from being elected, but we ignore appeals to help a good man when his opponent is not an identifiable devil. We are worried about our international misadventures, our domestic unrest, and the deterioration of our environment. Since we haven't willed or wished for any of these things, they cannot be our fault; if not our fault, they must be the fault of someone else, either someone who wishes us ill or whose perverted values and goals blind him to the evil he does. So, we create straw devils, in order to focus our indignation, to incite ourselves to remedial action, and to fix the blame away from ourselves.

41 Our international misfortunes then result from Communist ill will or industrial-military power lust, rather than our own mistakes. Our domestic unrest then stems from Eastern liberal propaganda or authoritarian repression, rather than our faults of intelligence and charity in dealing with racial and moral problems. Our environmental deterioration is then due to the greed of resource exploiters and industrial polluters rather than to our own reluctance to curb our voracious appetite for energy and material things, our strong disinclination to pay the costs of pollution abatement, and our insistence on the freedom to "family-plan" ourselves right out of what we regard as a tolerable existence.

41 Miners make good straw devils

41 The miner seems to make a peculiarly satisfactory straw devil. Miners have long been regarded by both nature preservationists and tillers of the soil as destroyers of nature and therefore evil men.

41 The miner-devil concept may be rooted in the basic fear of dark places, the mythology of the underworld, and the theology that - at least until Copernicus - placed Heaven in the sky and Hell within the earth. But there were more substantive reasons: more than 400 years ago Agricola wrote that farmers blamed miners for destroying fertile fields, cutting down woods and groves, driving away wildlife, poisoning streams, and corrupting mankind by the production of gold and silver. Incidentally, in refuting most of the arguments against mining, Agricola made an astoundingly modern proposition: that "birds, edible beasts, and fish" be purchased and stocked in mountainous regions with the profits from the mining and metals industry. n11

41 n11 Agricola (Georg Bauer). De re metallica, 1556, translated by H. C. and L. H. Hoover; New York: Dover Publ., 1950.

41 Mining accords with development ethic

41 To the nature mystic, miners personify the evilness of man as against the goodness of nature. They scar, despoil, desecrate, rape. Mining accords with the conquest or development ethic and during the winning of the American West was highly regarded; it conflicts with the preservation ethic, and as the desire to preserve natural portions of our environment grows stronger, mining tends to be viewed as both morally and ecologically wrong.

41 To some authors, mining degrades the miner as well as the environment; Lewis Mumford, for example, in "Technics and Civilization," holds that the habitual destruction and devastation of mining "brutalizes" the miner and says

there is indeed "something devilish and sinister about the whole business" of mining. n12 In the nature righteousness of a John Muir or an Aldo Leopold, there is no room for miners, except as devils. And it is as devils that miners appear, not only in sermons from the sierras of environmental piety, but in the pages of sub-objective periodicals like Harpers, the Atlantic, and the Christian Science Monitor.

41 n12 Mumford, Lewis. Technics and Civilization, New York: Harcourt, Brace and World, 1934.

41 Whatever one may think of the logic (or even the morals) of the nature or environmental moralists, their growing political muscle cannot be ignored by industry. And the extractive minerals industry is recognizing that its actions are being reviewed in political arenas that range from garden clubs and neighborhood bars to the public press and the U.S. Senate; that its plans and decisions no longer can be confined to a neat framework of economics, engineering, and the law; that it has both inherent and acquired disadvantages in the public arena; that it no longer has such a great advantage of initiative as it once enjoyed; and that it is fighting for its domestic life.

41 Nature moralism scorns multiple use

41 Today's politics of the environment are developing against a background of a new wave of reaction against the excesses of cities and the bad fruits of technology. The leaders of this reaction invest nature with both esthetic and moral qualities. There is a resurgent nature moralism that prescribes "right conduct" toward nature and which scorns multiple use as enjoyed rape.

41 In America, nature moralism descends from Thoreau and Emerson through Liberty Hyde Bailey, the Cornell dean of agriculture who urged his fellowmen to develop a sense of "earth righteousness;" through John Muir who at his death was called "the most rapt of all prophets of our out-of-door gospel;" and through Aldo Leopold who wrote that "a thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise." Tonight the campfires of the nature moralists dot many hillsides, and a measure of their growing confidence is their willingness of some of them to take on both Christianity and capitalism in their crusades.

41 As with Rousseau, who claimed that the victims of the Lisbon earthquake of 1755 deserved their fate for not living in the forests and fields where they would have been saved both morally and physically, there is a feeling that cities are evil and are built on the greed of the industrial establishment that fosters and requires cities. Very few people today dare to agree publicly

with Eric Hoffer when he says that "It's in the city that man becomes human; no noble ideas were ever conceived outside the city," n13 or, for the matter, with John Wesley Powell, conqueror of the Colorado canyons, who wrote "When a man loses faith in himself, and worships nature . . . he lapses into stagnation, where mutual or moral miasma is bred . . . . " n14

41 n13 Spoken by Eric Hoffer on TV special on himself, 1969.

41 n14 Powell, John W. "Methods of Evolution," Bull.Phil.Soc.Wn., v. 6, pp. li-lii.

41 Nature seen as mistreated by man

41 Man's struggle with nature for subsistence was very real to Americans of the 1930's, the time of the Great Depression and the Dust Bowl, of the New Deal and the Civilian Conservation Corps. In only 30 years, however, most Americans - because of the urban implosion and their rapidly rising standard of living - have become separated from direct knowledge of the physical sources of their food, clothing, shelter, fuel, and conveniences, and are shielded from any sense of struggle with nature for the elements of existence.

41 We now see statements that nature has always been essentially benign or friendly to man, and that in return he has horribly mistreated her. One is reminded of the long argument between those who saw the physical world as a divinely designed abode for man and those who, like Alfonso X of Castile and Leon, retorted, "Had I been present at the creation, I would have given some useful hints for the better ordering of the universe."

41 Can't reason with preservationists

41 The miner and the oil man, as obvious conquerors of nature, now face two kinds of adversary: the preservationists, many of whom live in cities where they enjoy the fruits of the drill while declaiming against its use; and the equilibrists, who would weigh all exploitation decisions in terms of total costs and benefits to the nation (or to mankid) and who would give the benefit of any doubt to the environment rather than to the exploiter.

41 The preservationists are implacable foes, who regard mining and miners as evil and whose environmental values are not commensurable; in other words they refuse to transmute their values into interests and to negotiate with those who have other interests. The equilibrists are reasoning critics who demand only that the inclusive cost-benefit ration of any proposed development project be demonstrably positive; within limits of health, their environmental values are commensurable.

{43} The preservationists cannot be reasoned with. The equilibrists can, for they agree with Aldo Leopold who said years ago, "We shall hardly relinquish the steam shovel, but we need gentler and more objective criteria for its [*] ." n15 With the preservationists, the old democratic rules of compromise, accommodation, and exchange of interests will not work, and it is no use to hope for a negotiated settlement. With the equilibrists, incommensurable values still can become real-life commensurables by the democratic process. Consequently, the mining industry should attempt to distinguish and keep separate these two groups, and to deal with each in a different way. With the "implacables," the appropriate mode is political warfare. With the

"defenders," the appropriate mode is political accommodation.

43 n15 Leopold, Aldo. A Sand County Almanac, New York: Oxford Univ. Press, 1966.

43 Whereas in political warfare, one tries to isolate the opponent from his potential allies, to induce him to attack straw targets and accept Pyrrhic victory, to incite him to fatal excesses of choler or malice (which may not work in a political environment where choler and malice appear to be regarded as virtues), or simply to outlast him, in political accommodation one tries to negotiate the most favorable settlement of a specific issue without unduly prejudicing one's future options.

43 Hard choices facing minerals industry

43 It is in this matter of prejudicing future options that the minerals industry faces its most critical political problems. Behind the numerous confrontations on specific issues lies a growing demand that the rules of the game be changed, a demand for new decision mechanisms which will allow the public and its representatives to compare alternative plans for developing a resource, be it a river valley, an oil field, or a mineral deposit, in terms of all the costs and benefits, both market and nonmarket; which will allow nondevelopment as an alternative; which will regard preserving options for the future as a benefit, and maintaining environmental quality as a practical goal; [See Illustration in Original] and which will allow the exploitation decision to be made on a best-alternative basis.

43 Some such mechanism may emerge from the smoke and flame of contemporary resource controversies. At the very least, formidable constraints will be placed on the initiative and options of the resource exploiter. The minerals industry is faced with some hard choices. Should it broadly defend, with financial tooth and legal claw, its present "rights" under the law?Should it negotiate on an ad hoc basis, only at those places and times where it feels forced to do so, hoping to preserve the present frame of the industry while

allowing a few alterations of the picture? Or should it participate in devising and implementing rather sweeping changes in the fundamental legal and economic framework of the domestic industry in the hope of staying in the new game, even though the rules may be different? I don't know the answer. *

43 * [Author's note: The report of the Public Land Law Review Commission was released after this paper was prepared. The recommendations of the Commission for changes in the mining laws appear to be an attempt to tidy up the playing field and return more of the receipts to the owners of the stadium without any fundamental change in the game itself. Mining on the public lands would still represent what the lawyers call "a selfinitiated right." E.C.]

SELECTED READINS

NATURAL RESOURCES AND ENERGY REQUIREMENTS

INTRODUCTION a chapter from mineral facts and problems, 1970 edition

55 UNITED STATES DEPARTMENT OF THE INTERIOR

{56} United States Department of the Interior Bureau of Mines

56 This publication is a chapter from Bulletin 650, MINERAL FACTS AND PROBLEMS, 1970 edition. The complete volume, covering all mineral commodities, may be pur. chased from the Superintendent of Documents, Washington, D.C. 20402, for $10.75.

{57} INTRODUCTION

57 By Warren E. Morrison n1 and Robert E. Johnson, Jr. n1

57 n1 Office of the Assistant Director, Mineral Resource Evaluation.

57 THE EVOLVING MINERALS ECONOMY

57 The first major evaluation of the nation's raw materials prospects after World War II was completed by the President's Materials Policy Commission (Paley Commission) in 1952 and submitted to the President in June of that year, as a five-volume study entitled Resources for Freedom. The bulk of the report was devoted to an analysis of the past, present, and probable future of the Nation's mineral supply industries.

57 The Commission's evaluation of the future situation regarding minerals was derived from its forecasts of the probable domestic demand for the major minerals in the 1970's. This demand analysis was made in the context of probable worldwide demand. Several crucial assumptions were made by the

Commission's forecasters. It was assumed in 1950 that the next 20 to 30 years would see no major wars and be a period of sustained economic growth. Another assumption was that the anticipated demand for raw materials must be supplied at essentially no increase in real cost in order to avoid crucial supply problems.The Commission's forecasts were derived within the context of the country's expected future rate of economic activity.The gross national product (GNP) growth to 1975 was derived from projections of the number of people in the labor force, hours of work, and an index of probable production measured per

unit of labor input. It was believed labor hours would decrease and labor productivity would increase. The result was a forecast GNP growth rate of 3 percent.

57 Operating within the framework of forecast GNP, approximately two dozen mineral commodities were analyzed by the Commission in terms of major industrial sectors that consumed the particular mineral. Forecasts for major consuming sectors were made through technologic evaluation of the growth of sectors. It was predicted that aluminum would displace copper for many electrical uses. Lead was forecast to be replaced entirely by plastic for cable covering.

57 The most sophisticated forecasts were in the energy area. The energy fuels were seen as competing with each other in the major markets, particularly for electricity generation. The Commission realized that a good possibility existed for the massive introduction of labor-saving capital equipment into coal mining, but concluded that the industry was too fragmented and financially weak to be able to incur the costs of mechanization. In retrospect, such mechanization has occurred, costs have fallen, and coal use in the electricity generation market has increased more rapidly than anticipated by the Commission. However, coal has lost other markets such as process heating more rapidly than anticipated a generation ago.

57 The Commission also concluded that domestic crude oil production would not be able to meet domestic demand at constant costs, and anticipated supplementary supplies from oil shale and coal liquefaction by 1970. It also felt that unrestrained crude imports would be necessary to keep costs and prices from rising. What actually happened is that petroleum prices declined. Oil from shale and coal is not yet profitable, and petroleum imports are restricted under a national control program.

57 The Commission's electricity consumption forecast was only two-thirds of the actual consumption level during 1950-70. This is partly explained by the fact that the average real price of electricity has declined 40 percent in 20 years. The case of natural gas is even more startling. The Commission's forecast of natural gas consumption turned out to be very much on the low side.

At the same time the real price of natural gas has risen more than the price of any of the other minerals analyzed by the Commission.

57 In general, the Commission's mineral consumption forecasts were neither consistently high nor low. The estimates for copper, lead, and coal were from one-quarter to one-third too high.The forecasts for the consumption of aluminum, crude oil, natural gas, and electricity were too low by one-quarter to one-half. The actual consumption figures for steel, ferroalloys, zinc, sulfur, and total electricity fell within 25 percent of the accuracy range.

{58} If the Paley Commission's commodity forecasts are adjusted to reflect the actual GNP growth of 3.5 to 4 percent rather than the anticipated 3 percent, individual forecasts that were low are improved somewhat. Aluminum, crude oil, and electricity are moved to within the 25 percent error range. But the shift is not dramatic. The adjustment for GNP error does not correct the forecasts substantially.

58 With the advantage of hindsight, it is now seen that the last two decades have demonstrated almost uninterruped growth in the economies of industrialized nations and major shifts in the demand pattern for minerals. While the United States has shared in this growth and is still the world's single largest minerals consumer, it no longer dominates the world scene. European countries and Japan have increased their demand for minerals at a much faster rate than the United States and account for an increasing portion of total world demand.

58 The geographic pattern of mineral production has also changed. Production has grown most rapidly in areas of the world that produced few minerals prior to World War II, such as the Near East, Africa, and Australia. Present indications are that further discovery and development of extensive mineral wealth in these and other areas that were formerly overlooked, will continue as new technologies and science are applied. The Arctic land masses hold great promise as a future source of minerals in spite of the forbidding climate which renders development a challenging and expensive task.

58 The actual U.S. mineral pattern in the last 20 years is characterized by a strong shift away from mineral self-sufficiency. The domestic minerals economy is now much more dependent on world mineral markets than it was in 1950, particularly for petroleum, iron, aluminum, and copper. This same shift has also been pronounced in other parts of the world. Europe, which was to a large extent self-sufficient in fuels a generation ago, depending largely on indigenous coal reserves, has in recent years shifted to a petroleum-dominated energy economy. Virtually all of the petroleum consumed is imported from the Near East and Africa. Europe also depends on outside sources for many of its

other mineral requirements.

58 Japan is an extreme example of a highly industrialized economy that has become almost completely dependent on imports for mineral raw materials. To support its industrial growth, Japan imports gas from Alaska, coal from Canada and the United States, oil from the Mideast and Indonesia, and iron ore, bauxite, and coal from Australia. Japan also imports large quantities of nonferrous ores from South America and southern Africa. To develop these sources, Japan has found it necessary, in many instances, to provide financing and technology for the development of these mineral supplies. The Japanese are even finding it expedient to finance development of coking coal reserves in the most capital-rich country in the world - the United States.

58 One result of the sustained rapid industrialization in many parts of the world since 1950 has been the establishment of complex worldwide markets for many of the major mineral raw materials. Not only are the industrial nations moving away from self-sufficiency, their dependence on single outside sources is also declining. Industrial nations draw on many diverse foreign sources, and the mineral producing countries export their raw materials to several or all the industrial countries.

58 It is impressive that the world's mineral producers to date have been able to satisfy this massive growth in demand for minerals in an orderly fashion. A generation ago there was anxiety that the United States and the rest of the industrial world would not be able to secure minerals except at steeply increasing costs. An impressive job has been performed by the suppliers of the world's mineral raw materials in the last generation, yet anxiety over the prospect of scarce supplies and more expensive minerals persists.

58 The Paley Commission's most important single recommendation was that there be a continuous attempt to anticipate the future, and adjust policy. One of the most important conclusions the Commission presented was that the job of insuring an adequate and dependable flow of materials at the lowest cost consistent with national security must be carried on cooperatively by Government and private citizens on a sustained basis. Emerging situations demand continuous reevaluations. Each generation should reassess its requirements for raw materials and adequacy of the resource base. The recent pervasive anxiety for the maintenance of the quality of our environment further calls for a reassessment of social and economic costs in the mineral industries.

58 THE FUTURE OUTLOOK

58 In assessing the progress of the minerals industry in the United States

during the two decades since 1950, two main influences stand out. These are the sustained high rate of economic growth and the revolutionary impacts of science and technology on the materials demand sectors.

{59} The influence of economic growth on the Nation's mineral industries derives from their vital character as suppliers of raw materials essential to the productive process, as well as from their high proportional contribution on a value-added basis to all goods and services, as represented in the gross national product (GNP). Until the 1960's, and average growth of 3 percent per year in the GNP was generally accepted as a sustainable rate. Actual experience since 1950 has shown GNP growth in constant dollars to be 3.5 to 4 percent annually. For the remainder of the century, the GNP growth rate is predicted as 4 percent. Population growth is predicted at 1.6 percent and industrial production at 4.2 percent. Growth of domestic mineral resource demand during the forecast period is forecast within a probabilistic range of 3.4 to 5.5 percent per year (tables 1 and 2). This growth is based on contingencies assumed for the future demand for some 88 mineral resources in this volume during the period 1968-2000.

TABLE 1. - Value of world primary demand for minerals,1968, and forecasts to the year 2000n1 n2

(Billion constant 1968 dollars, except as noted)

Commodity group	1968	Forecst range, 2000		Cumulative demand 1968-2000		Growth rate (percent)	
		High	Low	High	Low	High	Low
U.S. PRIMARY DEMAND							
Energy	20.4	103.2	48.1	1,740.3	1,087.0	5.2	2.7
Ferrous	2.0	6.1	4.3	116.1	94.4	3.5	2.4
Nonferrous	5.5	52.0	2 6.9	679.6	466.1	7.3	5.1
Nonmetallic	5.8	27.3	17.6	415.8	326.8	4.9	3.5
Total	33.7	188.6	96.9	2,951.8	1,974.3	5.5	3.4
REST-OF-THE-WORLD PRIMARY DEMAND							
Energy	35.9	184.8	110.1	2,919.1	2,066.1	5.3	3.6
Ferrous	7.1	20.4	14.3	393.4	326.1	3.3	2.2
Nonferrous	15.5	132.2	62.9	1,464.3	948.3	6.9	4.5
Nonmetallic	24.3	119.1	81.2	1,871.3	1,477.7	5.1	3.8
Total	82.8	456.5	268.5	6,648.1	4,818.2	5.5	3.7
TOTAL WORLD PRIMARY DEMAND							
Energy	56.3	288.0	158.2	4,659.4	3,153.1	5.2	3.3
Ferrous	9.1	26.5	18.6	509.5	420.5	3.4	2.3
Nonferrous							

s	21.0	184.2	89.8	2,143 .9	1,414.4	7.0	4.6
Nonmetallic	30.1	146.4	98.8	2,287.1	1,804.5	5.1	3.8
Total	116.5	645.1	365.4	9,599.9	6,792.5	5.5	3.6

59 n1 For detailed commodity breakdown, see tables 1 and 2 in Energy, Ferrous, Nonferrous, and Nonmetallic introductory sections.

59 n2 The range of forecast demand by end uses in many of the commodity chapters was subjected to a probability adjustment within two standard deviations about the mean. While recognizing that a totalling of the high-low ranges for competing or substitute commodities includes some further bias, this is shown to provide an order of magnitude of the probabilistic range of forecast demand by commodity groupings.

59 The second major influence on the domestic mineral industries, namely that of technology on evolving materials needs in major mineral end use markets, has had an even greater overall impact on the pattern and growth of the Nation's minerals supply and demand. Since the 1950's, new materials forms and end uses have been proliferating in response to the evolving needs of users in existing as well as new markets. Science and engineering have been altering properties, improving performance factors, and creating material combinations. Materials users are more and more concerned with these altered properties, performance factors, and combinations, and less with the primary resources they are derived from.

59 In contrast to these impacts of economic growth and science and technology on materials demand, there has been a lagging technological response from the mineral supply industries. As far back as 1950, the Paley Commission predicted that future trends of technology in the primary mineral resources industries might not be able to cope with the growing need to exploit lower grade raw materials to meet the rising demand within the current price structure. Twenty years later there is increasing evidence that the Paley Commission's fears regarding lagging technological progress in the mineral supply

TABLE 2. -Economic indicators used for forecast base projections to year 2000

Year	Gross national product (billion constant 1968 dollars)	Total U.S. population (millions)	FRB Index of Industrial Production (1968 = 100)
1964	562.6	192.1	80.0
1965	621.1	194.6	86.8
1966	698.4	196.9	94.6
1967	763.0	199.1	95.6
1968	865.7	201.2	100.0
2000	2,008.1	334.2	372.7

Annual growth rates, 1968-2000 (percent)	4.0	n1 1.6	4.2

59 n1 More recent estimates indicate that this figure may be too high; the current suggested rate is 1.35 percent.

59 Sources: GNP, Survey of Current Business, December 1968, Office of Business Economics.

59 Population, Population Estimates, March 14, 1968, Bureau of Census.

59 FRB Index, National Planning Association. industries have been realized. Total real costs within a number of primary minerals industries, especially in the nonferrous group, have apparently been rising at a faster rate than for the economy as a whole.

59 Many of the Nation's primary minerals industries continue to be oriented toward the production and primary processing of a single resource, with occasional related byproduct or coproduct output. It is increasingly difficult for raw materials suppliers to predict and interpret the changing needs of materials users in the demand sectors. Confusion and disruption on the supply side may occur either from sudden increases in resources demand that cannot be supplied at current costs or prices within existing capacity, or from abrupt declines in traditional markets with resultant surpluses or cutbacks. Despite the apparent healthy state of many mineral industries and the increasing demand for their output, the rate of new discoveries and development of reserves is declining for a wide range of minerals. Technology has not been forthcoming to lower costs and increase available supply from presently classified marginal and submarginal resources. The trend for a growing number of primary minerals is toward higher costs, a leveling off of domestic production, losses of traditional markets, recourse to substitutes, and increasing dependence on foreign sources of supply.

{60} Instead of a single heterogeneous source, materials needs are to an increasing degree met from some combination or mix of primary resources, which in turn is derived from a relatively fixed domestic resource base. The failure of some primary mineral industries to readily respond technologically and organizationally to the changing pattern of materials needs is having adverse effects of supply-demand relationships. It is essential that the growing gap between primary minerals supply and evolving materials demand in such industries be narrowed and some kind of balance restored. To achieve this reconciliation will require a number of changes and innovations in the domestic minerals industries, some already in progress and others yet to be implemented.

60 A first requirement is the extension of the technological revolution that has so drastically affected the growth and pattern of materials uses to the primary mineral industries on the supply side. To stem the rising tide of real costs in key mineral industries, science and technology will be called upon to increase available supplies at reasonable costs as well as to alter and broaden the properties of more abundant, lower cost available domestic resources, with the objective of increasing their substitution potential for scarce, high cost, or imported resources. Technology must be applied to broadening the recoverable portion of the resource base through development of new techniques of exploration and discovery for resources, lowering the cost of development of presently classified marginal and submarginal reserves, extending mineral supply through recycling, and maximizing the recovery and utilization of byproducts and coproducts.There is also a vital need for technological innovation with regard to the development of nondestructive approaches to resources and materials production and usage, and to assure the maintenance of the quality of the environment during the entire minerals cycle from production to final use.

60 A second prerequisite for closing the widening gap between minerals resources supply and materials demand is the need for a "goal oriented" approach to minerals planning, programing, and management. The rationale for this approach is that man is increasingly able to control and determine his future. To an increasing degree technology, as well as economic and social needs, can be literally planned, programed, and managed into reality. In the minerals area evolving user needs demand new technology which in turn generates new materials requirements and performance factors. To anticipate these shifts and to assure their success. alternative futures for materials uses and requirements can be forecast and simulated on the basis of contingency assumptions for future technology and other influences. From the contingency forecasting of alternative futures for minerals demand, predicted shifts in materials needs can be worked back to calculate the strain on the resource base and which resource mix will be required under the assumptions. More importantly, forecasts and simulations of future supply-demand relationships for minerals are useful for planning, prescribing, and managing needed change and innovation in the minerals area.

60 A third requirement for improvement of the working balance between primary resources and their materials uses is the restructuring of some minerals industries along horizontal and vertical paths. A number of industries that are presently oriented exclusively toward primary production and processing of single resources and their byproducts or coproducts are tending to merge horizontally into functional resource groupings that reflect major use patterns - such as energy, nonferrous, ferrous, and nonmetals uses. In a vertical process of integration some primary resource producers and processors are also becoming increasingly involved beyond the primary processing stages and tending

to integrate and merge with materials processing, manufacturing, and user industries. This process of evolution from a commodity to a functional approach in resources-material management is already apparent in the primary fossil fuels industries.

60 Many aspects of resource-materials interrelationships tend to be unique and characteristic of the specific minerals resources and materials uses to which they are applied. However, some general observations can be made with respect to probable levels of requirements for mineral resources to the end of

this century.

60 ALL MINERALS

60 Based on the aggregation of the contingency forecasts for some 88 mineral resources in the following chapters, it is estimated that the value of world primary demand for minerals by the year 2000 will range from about $365 to $645 billion in constant dollars. About one-quarter of [See Graph in Original] the total, or $9 7 to $1 89 billion, represents the value of the U.S. range of forecast mineral demand for the year 2000. Relating the range of forecast demand for the United States to the situation in 1968, the annual growth of total domestic minerals demand will range from 3.4 to 5.5 percent for the remainder of the century (table 1). Some idea of the magnitude of these future requirements for mineral resources, and an indication of the capital outlays that will be necessary to achieve them, are evidenced from the cumulation of the value of the probabilistic forecast rate of mineral resources demand between 1968 and 2000. For the United States, the cumulative value to the end of the century is $2.0 to $2.9 trillion, and for the world $6 .8 to $9.6 trillion (table 1). 62 In the last 30 years the United States has consumed more minerals than the entire world for all time before. Based on the forecasts for the year 2000 the total constant dollar value of demand for minerals in the Nation is expected to increase from three to five times the current level. This substantial increase will result from continuing economic and population growth and be characterized by increasing affluence, urbanization, and industrialization. Technological progress and innovation will continue to be the main influencing factors in the demand for all resources in the year 2000.

61 THE ENERGY GROUP

61 With respect to the energy group of mineral resources under known technology, the conventional fossil fuels - including petroleum, coal, and natural gas, the new fissile fuels including uranium and perhaps thorium, and hydropower - will be the principal energy sources for the remainder of this century. Increasing quantities of the fossil fuels supplemented by fissile

fuels will be required for the production of energy within the present conventional energy system of direct fuels utilization and secondary electricity generated from fossil fuel and nuclear plants. Nuclear reactors powered by uranium and eventually thorium are expected to account for an increasing portion of the electric power generating capacity and output. However, fossil fuel plants will still be the major source of utility electricity generated in the year 2000.

61 Contingency forecasts of the total demand for energy to the year 2000, in both constant dollars and British thermal units call for average annual energy growth rates ranging from 2.7 to 5.2 percent annually. The total calorific value of the cumulative requirement for energy resources to meet forecast domestic demand for energy in the United States to the end of the century is predicted within a range of 166 to 239 quadrillion British thermal units. In constant dollar value this represents $1.1 to $1 .7 trillion, or about one-third of the total forecast value of all mineral resources demand forecast for the period (table 1). Thus energy resources are expected to continue to dominate the total minerals requirement for the foreseeable future.

61 The technology of energy resources processing and utilization within the present conventional energy system has progressed to the point where virtually

all of the major fossil fuels, as well as the newer fissile fuels, are substitutable for each other in output of energy in the form of electricity or prcess heat. There is also increasing use of fossil fuels for nonenergy uses such as chemicals. As the demand for total energy grows, domestic fossil and fissile fuels compete and substitute for each other on the basis of cost-price relationships and their technical ability to meet the evolving requirements of energy forms and markets. In the case of petroleum about one-quarter of domestic demand is met from foreign

61 In response to the increasing demand for sources of supply. secondary energy in the form of electricity or heat, producers of primary fossil fuels - such as coal, oil, and gas - are beginning to group together, becoming energy companies producing a range of primary and secondary energy and raw material products. The most palpable recent evidence of this horizontal restructuring has been the movement of U.S. oil companies into the coal and uranium businesses. Primary oil companies are also integrating vertically by becoming increasingly involved in secondary materials processing and beyond, into the fields of petroleum chemicals and other energy and nonenergy material uses. In the process of moving from a commodity to a functional energy approach, primary energy resource producers are increasingly able to relate to the evolving forms and shifting uses of the demand sectors.

61 The principal problems anticipated for the rest of this century in respect to energy supply and demand are related to the technological limitations of the present conventional energy system and the required mix of resources necessary to sustain it. There is particular concern for possible future shortages of certain primary resources such as natural gas and uranium with respect to the known technology of the uses of these resources in process heat and generation of electric power. Another major cause for concern is the ability of the domestic petroleum industry to meet anticipated future demand for liquid fuels at world prices and what portion of future requirements will have to be met from foreign sources of supply under known and anticipated technology.

61 With respect to the present energy system, the inefficiencies and environmental problems of direct utilization of fossil fuels for space and process heat, transportation, and electricity generation are increasingly evident.There are also growing doubts concerning the efficiency of the system of long-distance transportation and related line loss of utility electricity generated at large thermal electric powerplants, using either fossil or fissile fuels. Finally the environmental problems of electric utility generation from conventional fossil fuel and nuclear power generating plants as well as direct uses of fossil fuels are of increasing national concern.

{63} It is believed that the conventional energy system, because of upper limits on its efficiency, the restraints of the resource base, and detrimental environmental effects, will evolve toward alternate systems for which technology is known but not yet commercially viable. Such known systems include improved all-electric systems based on fossil or fissile fuels and single-fuel systems such as onsite fuel cells. The latter might provide electricity and heat with full efficiency at part load, dispensing with long-distance transportation of power, and with no environmental problems such as are associated with thermal power.

63 Probabilities for the emergence into widespread commercial use of one or more of these energy systems before the end of the century depend on the relative efficiencies of such a system to meet forecast energy demand, the impacts on the resource base necessary to sustain it, and the environmental problems involved from either the system or resources side. For example, the present controversy on the relative efficiency of nuclear power versus conventional systems, the prospects of new technology such as breeder reactors, the potential problems of future uranium supply, and the general ecological problems of nuclear power must be analyzed within the larger context of alternative energy systems and resource mixes. Looking beyond the year 2000, increasing consideration will also have to be given to the eventual exhaustion of conventional energy resources within proved and possible energy systems and

the need for the introduction of exotic unproven systems, such as solar energy and fusion, to meet the nation's very long-term energy needs.

63 THE FERROUS GROUP

63 Within the ferrous group, iron predominates both in quantity and value. It is also the source of the key metal within the spectrum of metals, steel. Other components of the ferrous group serve principally as additive elements for forming alloys for steel and other metal combinations.The major alloys are manganese, silicon, chromium, nickel, cobalt, columbium, tungsten, tantalum, molybdenum, vanadium, etc. Whereas the value of primary domestic demand for iron is currently two-thirds of the total value of the ferrous minerals group, the alloy minerals, especially superalloys, are of increasing importance for bringing higher quality and improved performance factors to metals.

63 With respect to the ferrous position in total minerals demand, the group accounted for only 6 percent of the total value of domestic minerals demand in 1968. Based on the contingency forecasts made for the various components of the group to the year 2000, the domestic demand for ferrous minerals is forecast to grow at annual rates ranging from 2.4 to 3.5 percent during 1968-2000 (table 1). This is a somewhat slower rate than predicted for the other mineral groups - nonferrous, nonmetals, and energy. The reasons are believed to lie in anticipated increases in efficiency through new technology that will be brought to the iron and steel industry during the balance of the century, such as direct reduction, as well as the effects of substitution by materials derived from other minerals, including the nonferrous and nonmetallics.

63 The last decade has witnessed a revolution in the technology and economics of use of the ferrous group of metals. Much of this has affected supply requirements for higher quality ores and alloys. It is expected that the technological revolution will continue within the user industries, and will affect the future requirements for highgrade iron and superalloys.

63 The iron industry is expected to become increasingly user-oriented and responsive to changing materials forms and performance factors. These shifts will come from major consumers such as the construction and the transportation industries, as well as from the growing industrial processing and user markets. To an increasing degree the evolution of the domestic iron industry will also be contingent on the ability of the industry to maintain the quality of the environment on both the demand and the supply side. This will mean increased costs or the introduction of new technology to maintain costs at current levels.

63 The main tasks that face the ferrous group are quality improvement particularly with regard to the provision of special alloys and superalloys; richer iron ores from domestic sources or foreign sources at reasonable costs;

and the implementation of new technology to lower overall costs within the group, especially with respect to domestic resources presently classified as marginal and submarginal. Other requirements necessary to improve the economics of the ferrous group of minerals include direct reduction, improvement of methods of overland transportation of ore to reduce costs, reclaiming secondary metals from superalloy scrap, and improved byproduct and coproduct recovery from raw materials production. Improvement in metal recovery at all stages would significantly lower overall costs. Marine sources of ferrous metals also offer possible major new sources of supply and an opportunity to broaden the resource base. Finally technology is needed to further reduce the costs of producing domestic iron and also increasing the domestic availability of a number of the alloying metals.

{64} THE NONFERROUS GROUP

64 The nonferrous group range from the major industrial minerals - aluminum, copper, lead, zinc, mercury, magnesium, and titanium - to the precious minerals - gold, silver, and the platinum group. Within a broad spectrum of chemical and physical properties, these minerals meet a major portion of the evolving and diversified metals needs of the user markets.

64 The nonferrous minerals constitute the largest group within the total minerals complex, accounting for about one-sixth of the total dollar value of all minerals demand in the United States, as well as the rest of the world, during 1968 (table 1). Based on contingency forecasts of trends of demand to the end of the century, domestic demand for minerals of this group is predicted to expand faster than for the other groups, with annual rates of growth for 1968-2000 ranging between 5.1 and 7.3 percent.

64 The anticipated growth of value for the minerals in the nonferrous group will derive largely from growth in the major components of the group, aluminum and copper, magnesium and titanium, and the precious metals, gold, silver, and the platinum group. In the rest of the world, anticipated growth for nonferrous minerals is also expected to exceed that for the other groups (ferrous, nonmetallics, and energy). Based on the forecasts in the nonferrous chapters, rest of the world value is predicted to grow within a range of 4.5 to 6.9 percent annually during the rest of the century.

64 The domestic nonferrous mineral industries have been experiencing rising real costs and land use conflicts. In many nonferrous industries there has been a failure of technological progress to bring forth new recoverable reserves or decrease the cost of development of presently classified marginal and submarginal resources. For some of the minerals in this group, their byproduct-coproduct relationships with other minerals production places

limitations on the present and anticipated supply. In other instances, the persistent high costs of domestic production are being solved by recourse to foreign sources of supply. The environmental problems within this minerals group are also increasing on both the supply and demand sides.

64 The need to meet the rapidly growing domestic demand for the nonferrous minerals while maintaining the quality of the environment, maintaining real costs at reasonable levels, and assuring that the ratio of domestic production to imports is maintained are the major challenges for the nonferrous mineral industries. Much of the response to these challenges will have to come from new technology. There is also some benefit to be expected from the increasing

tendency toward horizontal and vertical integration among some of the mineral industries in this group. A number of copperproducing companies have expanded their operations to include the production of primary aluminum.Because of the many common markets shared by aluminum, magnesium, and titanium, the production and processing of two or more of these elements by single firms is likely to continue to expand during the remainder of the century. With respect to vertical integration, a number of major aluminum and copper companies are increasingly involved, beyond the primary processing stages, with materials needs and product end uses.

64 THE NONMETALLIC GROUP

64 The nonmetallic minerals are numerous and range from such bulk commodities as sand and gravel and stone, the annual domestic demand for which is quoted in billions of short tons, down to industrial diamonds and gem stones, which are measured in carats. The last three decades of this century will be a period of rapid growth for the nonmetallic mineral industries. The requirements for new buildings, road construction, rehabilitation of blighted cities, food production, chemical manufacture, ceramics, metalworking, and the host of other established uses of nonmetals can be expected to increase in volume. Of equal long-term significance are the opportunities to supplement and replace metals as they become scarce and expensive. Development of performance specifications will expand the use of composites of metals, nonmetals, and nonmineral materials in new and improved end products. Research leading to significant improvements in the properties of the abundantly available nonmetals also will enhance their utility.

64 In 1968 nonmetallics were the second largest group of minerals, accounting for one-sixth of the total dollar value of all primary minerals demand. Future demand, in constant dollars, is forecast to grow at average annual rates ranging from 3.5 to 4.9 percent to the year 2000 (table 1). The probabilistic forecast range is based on the contingencies assumed for the

nonmetallic mineral demand during the forecast period. Sand and gravel and crushed stone are expected to remain the largest value items in the group and to have the fastest rates of growth. In the rest of the world, growth rates to the end of the century are expected to be comparable to those predicted for the United States.

{65} The domestic nonmetallic mineral industries, with a few exceptions, should be able to provide adequate supplies from domestic sources at reasonable costs to the year 2000. For the exceptions, supplies can be obtained from foreign sources or alternatives such as substitutes. However, the maintenance of a high degree of domestic self-sufficiency will require solution of many technical and economic problems. For some commodities, such as quartz crystal, lump kyanite, corundum, and industrial diamond, synthesis from domestic raw materials offers a feasible solution to supply problems. Increased recovery of byproducts, improvement of technology enabling use of lower grade reserves, and improvements in production and transportation facilities and costs are other means of enhancing the domestic supply position. Maintenance of ample domestic supplies of the nonmetals provides a foundation on which the United States can adapt to anticipated future shortages when demand outruns supply of the scarcer minerals.

65 Serving, as nonmetallics do, extremely heterogeneous markets, there is less tendency toward vertical and horizontal integration than in some of the

metallic and fuel categories. However, there are advantages of scale and organization to be gained in some of the larger industries so there has been some consolidation among producers serving the construction and fertilizer fields. Continuation of this trend may be expected where efficiency benefits can be achieved.

65 Urban and environmental problems loom as major factors in the further development of the nonmetallic industries during the balance of the century. Nonmetallic minerals, mined predominantly by open pit methods, in large volume, have a variety of waste disposal and pollution control problems. Most urgent are those involving encroachment of urban development on mining operations and mineral reserves, particularly for bulk resources such as sand and gravel. Conflicting land use situations will have to be resolved through multiple land use programs. Publicly acceptable and economically feasible methods of controlling air and water pollution and waste disposal will also be required.

65 MINERALS PREDICTION

65 This edition of Mineral Facts and Problems features an expanded Outlook section in each of the 88 separate commodity chapters. The main objectives of

this new coverage are to analyze and forecast alternative future mineral supply demand relationships and to assess their impacts on the resource base. The emphasis on prediction in the 1970 edition is prompted by the increasingly complex relationship between primary resources availability and minerals uses, an acknowledged need for improved resources materials management, and the increasing role of planning in both Government and the private sector with respect to assuring the Nation's long-term needs within a fixed resource base.

65 The forecasting method used for predicting future mineral resource supply-demand relationships in each of the commodity chapters of this edition of Mineral Facts and Problems is called contingency or technological forecasting. The technological label is the one most frequently applied to the method and derives from the fact that much of the work done with the method to date has been involved with technological contingencies. However, in view of the method's potential for taking other influential variables or contingencies besides technology into account, the term technological can be misleading.

65 Briefly described, contingency forecasting consists of predicting and simulating alternate futures based on contingencies assumed for technological, economic, social, environmental, and other relevant influences. The contingencies and the assumptions for these are identified, quantified, and analyzed through "scenarios." The techniques used for the preparation of the scenarios may be described as eclectic or opportunistic since there is considerable flexibility for the use of judgment, experience, and intuition in the forecasting procedure. The method may avoid many of the rigidities of projection by trend extrapolation, such as mechanical curve fitting, or the uncertainties of trend correlation or econometric procedures wherein determining or influential variables cannot be precisely identified, quantified, and forecast within a mathematical framework. Conversely, any or all of these techniques may be applied as part of a technological forecasting procedure. Hence, the use of the term eclectic for describing the method.

65 One way to illustrate the use of method is to describe its application within a quantified model. In Mineral Facts and Problems, contingency forecasting for the major energy resources is carried out within the framework

of the Bureau's national energy model, featured annually in the introductory review chapter of the Minerals Yearbook, Volumes I-II, Metals, Minerals, and Fuels.

{66} The following is a discussion of the forecast techniques used in the "Bituminous Coal and Lignite," "Natural Gas," "Petroleum," and "Uranium" chapters of the 1970 edition of Mineral Facts and Problems. The methodology of the forecasts is discussed in three phases: First, the conditional projections to the year 2000 of current end uses for the major energy components in the Bureau of Mines 1968 energy balance; secondly, the calculation of deviations from these projections on the assumption of contingency situations leading to the establishment of probabilistic ranges of forecast demand; thirdly, the establishment and analysis of future supply-demand relationships for energy resources during the forecast period.

66 The first phase of the forecast procedure is the projection of the major forms and end uses of the resource components of the Bureau of Mines 1968 energy balance to establish a forecast base for each end use in the terminal forecast year. The projections are described as "surprise free" in that they merely reflect past trends and are conditionally related to forecasts for the growth of population, economic activity, industrial production, or other relevant indicators (table 2). The projections do not reflect any technological shifts or other contingency impacts on the energy components.

66 The forecast base for each of the major end uses of energy in the year 2000 is a point of departure for the second phase, which is the contingency forecasting exercise. This involves the establishment of contingency situations that are quantified as deviations from the forecast base projections. The contingency analysis is carried out within separate scenarios prepared for each end use. The scenarios set forth assumptions for alternative contingencies that will cause quantitative deviations from the year 2000 forecast base. Scenario contingencies reflect either threats or opportunities for each end use in terms of predicted technological, social, political, economic, environmental, and other relevant influences.

66 In this second phase, a forecast range of contingency demand is calculated for each end use of the major resources within quantitative limits established for both the high and low of the range. Aggregation of these high and low limits of the forecast range for each end use provides an aggregate forecast range of demand in the year 2000. Where the spread between the high and low limits of the aggregated forecast range for a particular mineral resource is extremely wide, the range is subjected to a probability analysis that includes adjustment of the forecast range for one to two deviations from the mean.

66 In each energy commodity chapter, a forecast range of demand for the subject resource is also established for the rest of the world in the year 2000. Because of the absence of comparable end use data for projection of the rest-of-the-world demand for mineral resources, the calculation of the year 2000 forecast range is based on the 1968 rest of the world totals. The rest of the world probabilistic forecast range is based resource in the year 2000 is derived from analysis of parallels with technology, demand, supply, and other influential variables anticipated for the United States. Expected deviations from the U.S. forecast range are reflected in adjusted growth rates for the rest

of the world.

66 The third phase of the contingency forecasting exercise consists of relating the energy demand forecasts for the year 2000 to available supply to determine future supply-demand relationships. The demand forecasts of energy components for the year 2000 can be worked back to the base year 1968 to establish whether cumulative requirements during 1968-2000 can be met from the available or predicted supply of primary energy resources. Strains on the resource base and the required energy mix necessary to meet contingency situations on the demand side can be assessed.

66 Analysis of probabilistic relationships between contingency demand and available supply under varying assumptions provides insights on future potential problem areas. An example is whether domestic supplies of natural gas or uranium in the United States and in the rest of the world will be available, at economic costs and prices, to meet the cumulative range of forecast demand for these resources to the year 2000. Alternative approaches and possible solutions to these and other potential problems may be simulated quantitatively within the model. On the demand side, contingencies may be simulated and assumptions varied to alter the forecast range for the energy components. On the supply side, alternative assumptions can be made for price-cost shifts, for technological progress leading to new discoveries or lower cost development of presently classified submarginal reserves, for shifts in the ratio of imports to domestic production, and for the introduction of substitutes to displace or supplement highcost energy resources.

66 With respect to the potential uses of contingency forecasts in the energy area, one of the main purposes is to provide insights into future supply-demand relationships and identify problem areas or opportunities. In table 4 in the Energy Resources summary, the probabilistic range of forecast demand is quite broad for most of the energy resources, and for any single component the precise point on the range where future demand is most likely to occur may be dependent on a complex set of interrelationships. However, where problem areas are identified, probability analyses can be used to establish most likely points on the range.

66 This brings us to what might be called a fifth phase of the contingency forecasting exercise - namely, its potential uses for planning, programing, and decisionmaking in the minerals area. Increasing concern with minerals problems both in the private sector and Government is related to identifying, anticipating, and providing for alternative approaches and solutions to threats or opportunities, sufficiently in advance for action to be taken. The establishment of goals or norms for the future, and the taking of prescribed action by the Government or the private sector, can greatly influence the

probability of success and make realities out of present contingencies. Man is to an increasing degree able to control and determine his environment. Within limits, technology, as well as economic and social needs, can be literally programed and managed into existence. With respect to technology, it can be said that all of the inventions or innovations that are likely to improve or change the existing minerals supply-demand system and the ability of the resource base to meet anticipated needs during the balance of the century have probably been identified. The same may be said of many of the other influences that will shape the pattern of future supply and demand. The real challenge of prediction, and of contingency forecasting in particular, is to identify and analyse the impacts of those contingencies most likely to achieve major prominence and large-scale development and have pronounced effects on the economy and the resource base. In addition to reducing uncertainty about the

future, contingency forecasting can also be a major tool for the management, provision, and assurance of future energy needs.

66 Past issues of Mineral Facts and Problems have been essentially "supply" oriented. The 1970 edition adds a new dimension to the minerals demand analysis by introducing material forms and end uses. This is accompanied by the prediction of the evolution of such uses to the year 2000 and the possible impacts on the resource base from contingencies assumed for demand.

66 In the scenarios on future mineral uses in the Outlook sections of the 88 commodity chapters, in the 1970 edition, considerable care has been taken to include all of the assumptions and analysis leading to these contingencies. Readers are invited to simulate other forecast ranges based on alternative assumptions. The quality and depth of analysis in these scenarios reflect the amount of information and data available for each resource, as well as the judgment, intuition and experience of the analyst. It is hoped that useful dialogues will ensue between Bureau of Mines analysts and knowledgeable persons elsewhere in the Government and in the private sector on the subject of the contingency analyses and forecasts carried out in this edition. Authors will welcome all critical comments and suggestions for revisions in the next edition of Mineral Facts and Problems. In the intervening years between the 5-year editions of Mineral Facts and Problems, the Bureau of Mines plans to make annual adjustments and revisions to these contingency forecasts. This is necessary to reflect new information, improved data, identification of new problem areas, and to assess the prospective impacts of new technologies, and other contingencies that will affect the future supply-demand relationships for mineral resources.

SELECTED READINGS

NATURAL RESOURCES AND ENERGY REQUIREMENTS

ENERGY RESOURCES

70 The demand for energy in the United States has been increasing at an average rate of 3.1 percent annually for the last 20 years.Gross consumption of energy resources in 1968 was 62 quadrillion British thermal units (Btu), having a value of approximately $20 billion.

70 Rest of the world energy demand has grown at a rate nearly double that of the United States in recent years. The greatest growth has been in the highly industrialized countries of Europe and Asia; however, commercial energy consumption in less developed regions is now growing at an even faster rate than in the highly developed areas. In 1968, energy consumed outside the United States was valued at approximately$36 billion.

TABLE 1. - U.S. primary production and demand for fuel minerals, 1968, and forecasts to the year 2000 n1 n2

Average unit price
Commodity   Quantity units   Value units   (1968 dollars) n3
1968
Year 2000 primary production, constant ratio n4
1968
Primary production   Value (million   Primary demand
2000   (quantity)   dollars)   (quantity
Value (million
dollars   High   Low
Value (million
Quantity   dollars)   Quantity
Value (million
dollars)
Anthracite   Thousand short tons Short ton   8.48
12.40   11,461   97.2   10,160
86.2   4,100   50.8   1,100
13.6
Bituminous coal   Million short tons do   4.67
4.67   545   2,545.2   499

2,330.3   2,884   13,468.3   1,393
6,505.3
Carbon   do   do   22.00
22.00   32   704.0   25
550.0   76   1,672.0   46
1,012.0
Helium   Million cubic feet Thousand cubic feet 30.00
60.00   867   26.0   842

25.3 3,710 222.6 1,440
86.4
Hydrogen do do .25
.22 2,060 515.0 2,060
515.0 15,500
3,410.0
Do do do
n6 .35
52,530 18,385.5
Natural gas (dry) Billion cubic feet do
n6 .262
54,900 14,383.8
Do do do .164
.410 18,504 3,034.7 18,957
3,108.9 34,300
14,063.0
Peat Thousand short tons Short ton 11.68
11.68 619 7.2 907
10.6 1,637 19.1 818
9.6
Petroleum Million barrels Barrel 2.81
2.90 3,879 10,900.0 4,900
13,769.0 13,000 37,700.0 5,800
16,820.0
Shale oil do do 3.00
3.00 n(7) n(7) n(7)
n(7) 2,000 6,000.0
Thorium Short tons Pound 6.82
3.40 110 1.5 110
1.5 2,500 17.0 240
1.6
Uranium do do 9.43
20.00 10,463 197.3 2,700
50.9 51,000 2,040.0 48,100
1,920.0
Total XX
XX XX 18,028.1 XX
20,447.7 XX 93,959.1 XX
43,841.5
Year 2000 forecast
range primary
Commodity Quantity units Value units demand
1968-2000 cumulative primary demand
Growth rate n5 (percent)
High
Low High

Low High Low
Quantity

COMMITTEE PRINT 95TH CONGRESS,1ST SESSION DECEMBER 1971

Value (million
dollars) Quantity Value (million
dollars) Quantity
Value (million
dollars) Quantity Value (million
dollars)

Anthracite Thousand short tons Short ton 3,600
44.6 1,000 12.4 198,800
2,075.5 122,000 1,273.7 -3.2
-7.5

Bituminous coal Million short tons do 2,639
12,324.1 1,275 5,954.3 41,833
195,360.1 26,955 125,879.9 5.3
3.0

Carbon do do 60
1,320.0 36 792.0 1,300
28,600.0 700 15,400.0 2.7
.4

Helium Million cubic feet Thousand cubic feet 3,600
216.0 1,400 84.0 59,400
2,673.0 34,900 1,570.5 4.5
1.5

Hydrogen do do
15,500 3,410.0 520,000
148,200.0 220,000 62,700.0 10.6
6.5

Do do do 52,530
18,385.5

Natural gas (dry) Billion cubic feet do 55,700
14,593.4

Do do do
34,800 14,268.0 1,130,000
379,680.0 860,000 288,960.0 3,4
1.9

Peat Thousand short tons Short ton 2,400
28.0 1,200 14.0 50,000
584.0 30,000 350.4 3.1
.9

Petroleum Million barrels Barrel 16,400
47,560.0 7,300 21,170.0 308,000
877,800.0 195,000 555,750.0 3.8
1.3

Shale oil do do 2,000
6,000.0 20,000

60,000.0 n(7) n(7)
Thorium Short tons Pound 2,500
17.0 240 1.6 25,000
255.5 5,400 55.2 9.8
2.4
Uranium do do 67,000
2,680.0 61,000 2,440.0 1,530,000
45,043.2 1,191,000 35,063.0 10.2
10.6
Total XX
103,168.6 XX 48,146.3 XX
1,740,271.3 XX 1,087,002.7 5.2
2.7
[See Table in Original]

70 XX Not applicable.

70 n1 Small differences between data in this table and commodity chapters due to rounding.

70 n2 The range of forecast demand by end uses in many of the commodity chapters was subjected to a probability adjustment within two standard deviations about the mean. While recognizing that a totalling of the high-low ranges for competing or substitute commodities includes some further bias, this is shown to provide an order of magnitude of the probabilistic range of forecast demand by commodity groupings.

70 n3 Price base used in calculating energy values are described in the individual chapters.

70 n4 Quantity of primary minerals that would be derived from domestic sources if present primary supply-demand ratios are maintained.

70 n5 Growth rates for individual commodities were based on demand quantities; total was calculated on demand values.

70 n6 Used to calculate high values.

70 n7 Less than 1/2 unit.

{71}
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TABLE
2. -

Rest-of-the-world demand for fuel minerals, 1968, and forecasts to the year 2000

Average
Quant unit price Cumulativ
ity Value (1968 e 1968-
units units dollars) 1968 2000 2000
Valu
e (
mill
ion
Quan doll

1968 2000 tity ars) High Low High Low
Valu Valu Valu Valu
e (e (e (e (
mill mill mill mill
ion ion ion ion
Quan doll Quan doll Quan doll Quan doll
tity ars) tity ars) tity ars) tity ars)
Value
(
milli
on
Quant dolla
ity rs)
Thous
and 5,06 4,95
Anthr short Short 194, 1,64 135, 1,67 125, 1,55 3,00 52,8 0,00 51,6
acite tons ton 8.48 12.40 000 5.1 000 4.0 000 0.0 0 57.7 0 78.0

Milli
Bitum on 360, 296,
inous short 1,70 7,97 3,40 15,8 2,30 10,7 77,3 991. 63,4 078.
coal tons do 4.67 4.67 8 6.4 0 78.0 0 41.0 00 0 00 0
132, 107,
Carbo 3,23 5,41 3,58 6,00 000. 4,90 800.
n do do 22.00 22.00 147 4.0 246 2.0 163 6.0 0 0 0 0
Milli Thous
on and
Heliu cubic cubic 1,00 9,70 436. 3,40 153.
m feet feet 30.00 60.00 50 1.5 0 60.0 200 12.0 0 5 0 0
2,99 24,9 600, 171, 330,
Hydro 5,00 748. 50,0 5,48 000, 000. 000, 94,0
gen do do .25 .22 0 8 00 9.0 000 0 000 50.0
63,9
n1 50,0 22,3
Do do do .35 00 82.5
Natur
al 115,
gas (n1 000, 30,1
dry) do do .262 000 30.0
1,40
10,6 70,0 0,00 470, 970, 325,
88,0 1,75 00,0 28,7 0,00 400. 000, 920.
Do do do .164 .410 00 2.8 00 00.0 0 0 000 0
Milli
on 113,
short Short 2,56 4,67 3,50 9,70 296. 8,20 95,7
Peat tons ton 11.68 11.68 220 9.6 400 2.0 300 4.0 0 0 0 76.0
Milli
on 1,55 1,06
Petro barre Barre 9,90 17,8 55,0 99,0 30,0 54,0 865, 7,00 590, 2,00
leum ls l 1.80 1.80 0 20.0 00 00.0 00 00.0 000 0.0 000 0.0
Shale 1,00 3,00 300. 7,40 22,2 2,00 6,00
oil do do 3.00 3.00 30 90.0 0 0.0 100 0 0 00.0 0 0.0
Thori short 5,60 1,03 59,0 603. 17,9 182.
um tons Pound 6.82 3.40 88 1.2 0 38.1 8 7.1 00 0 00 9
1,30

Urani 2,20 64,0 2,56 55,0 2,20 0,00 38,2 900, 26,4
um do do 9.43 20.00 0 41.5 00 0.0 00 0.0 0 72.0 000 96.0
184, 110, 2,91 2,06
35,8 806. 089. 9,05 6,13
Total XX XX XX 80.9 XX 6 XX 1 XX 6.2 XX 3.9

[See Table in Original]

71 XX Not applicable.

71 n1 Used to calculate high values.

{72}

10 ENERGY RESOURCES *10*

TABLE 3. - Estimates of energy resources of the United States and cumulative demand, 1968-2000

Resource	Units	Estimated recoverable resources n1: Quantity	Estimated recoverable resources n1: Trillion Btu	Cumulative demand, 1968-2000: High: Quantity	High: Trillion Btu	High: Percent of recoverable resource	Low: Quantity	Low: Trillion Btu	Low: Percent of recoverable resource
Anthracite	Million short tons	n2 6,485	167,000	199	5,000	3	122	3,000	2
Bituminous coal and lignite	do	n3 773,453	19,557,000	41,833	1,058,000	5	26,955	656,000	3

Petrole Billion 2,975,0 1,730,0 1,096,0
um n4 barrels n5 532 00 308 00 58 195 00 37
Natural Trillio
gas n cubic n6 2,477,0 1,166,0

(dry) feet 2,400 00 1,130 00 47 855 822,000 33
Oil in
bitumin
ous Billion
rocks barrels n7 4 23,000
Shale
oil do n8 80 464,000 20 116,000 25 0 0 0
Uranium Short n9 n10 1,367,8 1,126,9
(as U) tons 552,500 325,000 24 804,000 248 92 663,000 204
n12
Thorium n11 2,901,0
(as Th) do 527,000 00 25,000 138,000 5 5,400 28,000 1
[See Table in Original]

72 n1 See Mineral Facts and Problems commodity chapters for data sources.

72 n2 At 50-percent recovery.

72 n3 At 50-percent recovery; approximately 928,000 at 60-percent recovery.

72 n4 Includes crude oil and natural gas liquids.

72 n5 Includes proved reserves: 30.7 billion barrels of crude oil and 8.6 billion barrels of natural gas liquids reported by the American Petroleum Institute.

72 n6 Includes 287.4 trillion cubic feet of proved reserves reported by the American Gas Association.

72 n7 An approximate average of the minimum and maximum estimates of recoverable reserves of oils in surface and near-surface oil-impregnated rocks in the United States, which are shown as 2,495 million barrels and 5,483 million barrels, respectively, in Bureau of Mines Monograph 12, page 7.

72 n8 At 50 percent of the in-place oil of only the shales averaging 30 to 35 gallons per ton, lying less than 1,000 feet below the surface and recoverable by the demonstrated room-and-pillar method of mining (a small portion of the deposits from which oil eventually may be extracted using other technology).

72 n9 Reasonably assured reserves of U3O8 at less than $1 0 per pound, contained in measured and indicated ore, are estimated at 300,000 tons; the U3O8 content of inferred ore deposits is estimated at 350,000 tons. Uranium content of the 650,000 tons of U3O8 in both categories is 552,500 tons.

72 n10 With present technology; theoretical maximum energy equivalent is approximately 39,000,000 trillion Btu or 39 quintillion.

72 n11 Reasonably assured reserves of ThO2 at less than $1 0 per pound, contained in measured ore, are estimated at 100,000 tons; the ThO2 content of inferred ore deposits is estimated at 500,000 tons. Thorium content of this 600,000 tons of ThO2 in both categories is 527,000 tons.

72 n12 With present technology, theoretical maximum energy equivalent is approximately 37 quintillion Btu.

72 Primary production and demand for individual mineral fuels in 1968 and forecasts to the year 2000, for the United States and the rest of the world, are shown in tables 1 and 2, respectively. As indicated, the cumulative demand for major energy resources from 1968 to the year 2000 is enormous. Also, it is anticipated that would demand for major mineral fuels will exceed current levels by 2 to 5 times in the year 2000, depending upon technological, economic, environmental, and related contingencies.

72 In combination, there is an abundance of energy fuels throughout the world to meet all foreseeable levels of demand to the year 2000 and beyond, with the United States being adequately endowed with indigenous resources to assure self-sufficiency in this respect, either directly or through conversions.
Nuclear power will improve its position tremendously in the energy system, and hydropower as we know it today will continue to provide a nominal amount of energy. Although the total of energy resources in the United States is only a relatively small part of world resources, the United States has been the most enterprising country in employing them to advance its economy and standards of living, and in upgrading and broading its fuels resource base in keeping with its technological needs.

72 The primary sources of energy currently consumed in the United States include petroleum, natural gas, bituminous coal and lignite, anthracite, hydropower, and uranium. Minor sources include wood and geothermal steam. Oil shale may become an important source of oil and gas, though it does not yet supply any of the domestic energy consumed commercially. Solar energy, the greatest source of heat, is yet unharnessed except on a very limited scale. The fossil, or hydrocarbon, fuels are by far the largest contributors of energy in the United States, at present supplying approximately 96 percent of the Nation's

gross energy inputs. The balance is provided largely by hydropower, and nuclear plants supply a very small amount. In addition, a small percentage of fossil fuels is used as a source of raw materials.

72 The possible range in cumulative domestic requirements for each of the major energy resources during the period between 1968 and the year 2000 is indicated in table 3. The high and low ranges were estimated on the basis of contingency forecasts of the impact of technological, environmental, economic, social, and related factors on the demand for the respective resources, with their major end uses.

72 The estimated recoverable resources available at current prices with today's technology in both the United States and the rest of the world are ample in total to meet all foreseeable energy requirements to the year 2000 and well beyond.

72 Technologic advances are anticipated that could substantially increase the amount of economically recoverable resources. The technological factors that may have the most pronounced effect upon individual fuel supplies are the rate of development of fast breeder nuclear reactors to improve fuel consumption and electricity generation efficiency, continued mechanization and advanced mining and transportation systems in coal mining, new or improved exploration and recovery methods for petroleum and natural gas exploitation, and altered energy forms such as the production of synthetic gas from coal.

{73} There is a high degree of potential substitutability among the various fuels, and new or improved conversion and utilization technologies are

expected to change the quantities and forms in which fuels are used. Conversion of solid and liquid fuels to electricity and gas will be accelerated by the development of improved electric generation methods, gas synthesis processes, and fuel cells. Development of an electric car as a substitute for the internal combustion engine and increased use of direct reduction processes and electric furnaces in place of coke in iron and steel making are examples of utilization technologies that may have a profound impact on individual fuels.

73 Increasingly, environmental and social considerations can be expected to constrain the supply and limit the use of direct fuels to those that are nonpollutant. Land use and ecological considerations may restrict strippable coal supply. Increased concern with health and safety standards in mining will accelerate mechanization. In turn, demands for skilled in place of unskilled labor may present manpower problems of such magnitude that coal output is constrained.

73 Other factors influencing domestic fuels supply are changes in supply sources. New discoveries of large petroleum and natural gas resources in Alaska, increased exports of coking quality coals, and greater imports of petroleum and natural gas, including liquefied natural gas, are examples of recent developments. Imports of petroleum, natural gas, and uranium, all of which are more abundant in foreign countries, are expected to become more important as supplemental supply sources. The level of imports is subject to Government regulations, and changes in the present oil import program are under consideration. Drastic changes would produce substantial impacts on individual fuel markets, such as electric power generation on the east coast.

73 As we move into the 21st century, energy systems will depend less on fossil fuels and more on natural heat and power forces. The sum, the oceans, and geothermal heat will emerge as viable sources of energy.

73 The energy market constitutes four major consumer sectors: Transportation, industrial, household and commercial, and electricity generation (utilities). Table 4 shows energy consumption in the United States, by these major consumer classifications, and energy sources in 1968 and contingency forecasts for the year 2000.

73 In 1968, the percentages of total gross energy utilization (62,424 trillion Btu) contributed by the respective energy sources, by market sectors, were as follows:

Energy source	Percent			
	Household and commercial	Industrial	Transportation	Electric utilities generation.
Oil	48	23	96	8
Natural gas	48	48	4	23
Coal	4	29		51
Hydropower				17
Nuclear				1
Total	100	100	100	100

73 The relative position of electricity in the energy mix has increased in the last two decades at the expense of direct fuel use. This is demonstrated by the following tabulation of the percentage distribution of energy resource use by form:

Form	Percent	
	1948	1968
Direct fuels n1	82	72
Utility electricity generation	14	23

Raw materials	4	5
Total	100	100

73 n1 Includes miscellaneous and unaccounted for.

73 The consumption of energy resources as raw materials for the production of petrochemical feedstocks, asphalt, road oils, lubricants, and miscellaneous products is growing both absolutely and as a percentage of the total, with petrochemical feedstocks the dominate use.

73 Whereas coal was the major fuel source at the beginning of the century in the United States, and continues to be in most world areas, petroleum and natural gas became the dominant sources of overall energy supply in the United States before midcentury. This shift was in response to the changing nature of steadily increasing demand (which increased 84 percent between 1948 and 1968) as reflected by the phenomenal growth requirements for gasoline and related products, overriding factors of convenience, and new technologies of energy utilization that tended to discount cost differentials.

73 By the year 2000, total energy consumption is expected to increase from the 1968 level of 62 quadrillion Btu to a range of 166 to 239 quadrillion Btu. The low and high forecasts presented in table 4 for the supply of and demand for the respective energy sources in the year 2000 are based on a variety of contingency assumptions and adjustments that are explained in the individual commodity chapters.

73 As indicated in table 4, the growth in demand for electricity generation by utilities is expected to be the major phenomenon in the energy market. This is particularly apparent when

{74}
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TABLE 4. - Consumption of energy resources by major

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2000
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Low   6,1
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e   75   2   800 242 318 92 236 142   142 0   906 048
High   6,9
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e   500 13   000 90 227 938 40 940 681 774   774 0   643 417
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1968 3,15   188, 5,5 8,9 9,2 812 4,4 348   643 598 2,0 687
np   2)   (80) 450) 36) 71) 58))   74))   )   .3) 44))
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e   850) (21) 74) 99))   )   45) 67))   )   )   4))   )
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rang 2,85   744, 127 097 772 4,8 783 754 999   996 15. 677 673
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e 20 78 394 93 71 14 14 .2 451 65
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e 675 17 00 802 40 89 23 138 46 88 74 .2 77 51
High
rang 2,60 180, 4,9 2,1 2,1 1,6 8,8 7,7 7,7 854 2,9 10,
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[See Table in Original]

74 np Preliminary.

74 n1 Excludes natural gas liquids.

74 n2 Petroleum products including still gas, liquefied refinery gas, and natural gas liquids.

74 n3 Represents outputs of hydropower and nuclear power converted to theoretical energy inputs at the prevailing average heat rate at central electric stations. Excludes inputs for power generated by nonutility plants which are included within the other consuming sectors.

74 n4 Gross energy is that contained in all types of commercial energy at the time it is incorporated into the economy, whether energy is produced domestically or imported. Gross energy comprises inputs of primary fuels (or the derivatives) and outputs of hydropower converted to theoretical energy inputs. Gross energy includes energy used for production, processing, and transportation of energy proper. Industrial sector includes 295 trillion Btu "Miscellaneous and unaccounted for."

74 n5 Utility electricity, generated and imported, distributed to the other consuming sectors as energy resources inputs. Distribution to sectors is based on historical series in the Edison Electric Institute Yearbook. Conversion of electricity to energy equivalent by sectors was made at the value of contained

energy corresponding to 100-percent efficiency using a theoretical rate of 3,412 Btu per kilowatt-hour.

74 n6 Energy resource inputs by sector, including direct fuels and electricity distributed. Industrial sector includes 295 trillion Btu "Miscellaneous and unaccounted for."

74 n7 Includes bunkers and military transportation.

74 n8 Adjusted from 43,374 and 28,917, respectively.

74 n9 Average heat rates: 10,582 Btu/kwhr in 1968; 8,000 Btu/Kwhr the year 2000.

{76} ENERGY RESOURCES energy inputs to the three consuming sectors are adjusted to include purchased electricity distributions as shown in the last column in the table. It is estimated that total gross energy inputs into electric power generation will increase between 400 and 500 percent between 1968 and the year 2000.

76 Among the many factors supporting these estimates are heavily increasing demands for air conditioning, acceleration in the shift by many industries from the self-generation of power to purchased electricity, and dynamic technological progress in electronics and in the development of new uses for electricity in homes and businesses.

76 Principal among the influencing factors on power generation will be tremendous growth in nuclear energy, from 130 trillion Btu in 1968 to an estimated range of 31,327 to 40,965 trillion Btu in year 2000. The timing, extent of growth, and relative efficiences in nuclear generation in relation to total energy demand will strongly influence the extent of interchangeability among the respective energy sources in meeting total requirements.

76 The changing role of fossil fuels in electric power generation will depend substantially on nuclear technology. Based on differences in contingency assumptions in this respect, the adjusted percentage participation of the respective energy resources as inputs to power generation will be as follows:

Source	1968	2000	
		Low fossil	High fossil
Nuclear	1	54	37
Coal	51	30	40
Natural gas	23	6	10
Oil	8	3	8

Hydropower	17	7	5
Total	100	100	100

76 Notwithstanding an anticipated phenomenal increase in the utilization of nuclear energy, oil and natural gas will be the predominant energy sources. Petroleum will continue to be the largest single source of primary energy throughout the balance of the century, principally because of heavy demands in the transportation market and for petrochemical feedstocks. In the low range of estimated total demand, natural gas follows closely as a source of energy; however, it is exceeded by coal in the high range of demand. Coal's position in the high range results from the inclusion of approximately 30,000 trillion Btu in coal equivalent of synthetic fuels that could be required, in addition to synthetic fuels from oil shale, to supplement supplies of conventional oil and gas.

76 In summary, future energy supply and demand will be characterized by significant shifts in the nature of the energy mix. These shifts will be influenced by the rate of total energy growth, the relative availabilities of the respective energy sources, their cost-price relationships, and changes in technologies of production, distribution, and utilization of the respective sources. The major tasks ahead for the resolution of energy problems are those related to (1) the need for new technologies to improve the efficiencies of present conventional energy systems, (2) the need to improve production and use of energy fuels to meet urgent requirements to end or drastically reduce air and water pollution and other environmental concerns, and (3) the need to develop entirely new energy systems because of possible limitations of the resource base and efficiencies of conventional systems.

{77} [From the Congressional Record]

77 REMARKS BY ROGERS C.B. MORTON, SECRETARY OF THE INTERIOR, AT A MEETING OF
THE INTERSTATE MINING COMMISSION, LEXINGTON, KY., OCTOBER 21, 1971

77 It was a most fortunate day . . . April 27th of this year . . . when officials from Kentucky, North Carolina, Oklahoma, and Pennsylvania met at Raleigh to create this interstate body that is committed to improving surface mining and other practices of mineral extraction.

77 The Interstate Mining Commission came about because of initiative exercised by these states.

77 While the powers of the Commission are of a recommendatory, consulting nature, its very existence can foster many needed changes in the practices and

conditions of the mineral industry.

77 The membership of your Commission seems likely to increase . . . and I sincerely hope that it will. I know during your founding meeting at Raleigh, you urged all other states that have surface mining operations to give serious consideration to joining your compact. Keep after them.

77 The increasing demand for coal and other minerals and the industry's improved recovery ability have increased mining activity, especially in strip mining. This industry is an important link in our economy, but we must realize that it is capable of disastrous effects upon the environment.

77 It is the surface mining industry that, in the future, will provide a strong domestic mineral supply base and prevent our dependence on foreign sources of mineral raw materials from becoming dangerously large or prohibitively expensive.

77 Surface mining in 1969 accounted for 94 percent of all domestic production of crude metallic and nonmetallic ores: 2.45 billion tons compared with 165 million tons from underground mines.

77 Approximately 38 percent of all coal in 1969 came from surface mines. Preliminary data for 1970 indicates that this figure has risen sharply to 44 percent.

77 On a comparison basis, surface mines in 1969 produced 218 million tons and 269 million tons in 1970. Underground mines produced 347 million tons in 1969 compared with 338 million tons in 1970. Only the sharp increase in surface-mined coal enabled the industry to meet demand last year.

77 Many in the coal industry are saying that surface mining in 1971 will overtake underground mining and that - for the first time in history - more coal will come from above ground than below.

77 That prediction could very well come true. If surface mining doesn't overtake underground mining in 1971, it seems bound to occur soon.

77 While we find ourselves in a period of expanded reliance on surface mining, we are also, in 1971, facing an environmental imperative.

77 More than three million acres of land have been disturbed by surface mining and approximately 150,000 acres are added each year. If the trend continues, by 1980, some 5 million acres will have been affected by mining activity. Much of this acreage has been rendered inaccessible, unsightly and disgraceful.

77 Drainage is one of the terrible penalties of surface mining. Our lakes and streams become polluted when acid mine drainage, leaching liquors, processing plant chemicals and mine waters with high iron content are released untreated to local water systems.

77 Runoff from denuded surface-mined land and mine waste accumulations cause siltation of stream channels and possible flooding in affected drainage basins.

77 Stagnant water in strip pits is a breeding ground for insects and a hazard to public safety.

77 As of 1967, surface and other forms of mining had adversely affected fish and wildlife habitat in 13,000 miles of streams . . . 281 natural lakes . . . and 168 reservoirs and impoundments.

77 In 1969, the stripping of overburden and the removal of ore by surface mining in 20,314 active surface mines disturbed an estimated 193,000 acres of land. About 38 percent - 73,000 acres of this land - was disturbed as the result of coal mining activity.It is estimated that coal mining disturbed 90,000 acres in 1970.

77 This is an absolutely abhorrent form of land use which should not be tolerated.

77 The land is our greatest resource. We are merely temporary tenants upon a good earth which will remain a hundred thousand years after we're gone. A lot of folks will want to use it in that time, so, while we are in custody of it, nothing but the highest forms of stewardship should be acceptable.

77 I believe, in 1971, that the environmental disturbances engendered by unrestrained mining practices are neither inherent in the mining process, or an economic necessity. I also know that, with proper controls and enforced reclamation, adverse environmental effects can be minimized and held well within acceptable limits.

{78} NATIONAL COAL ASSOCIATION

78 Coal Building/1130 Seventeenth Street, Northwest/Washington, D.C. 20036/NAtional 8-4322

78 (For Thursday a.m.'s, Sept. 16)

78 SURFACE-MINED COAL IS USED TO GENERATE ALMOST ONE THIRD OF NATION'S
ELECTRIC POWER, COAL EXECUTIVE SAYS

78 WASHINGTON, Sept. 15 - Surface-mined coal is used to generate almost one third of the electric power that lights, heats and cools homes, business and industrial enterprises throughout the country, Carl E. Bagge, president of the National Coal Association, said today.

78 The electric utilities are the heaviest users of coal in the nation, Mr. Bagge pointed out, relying on it for half of their steam-generating capacity. A survey just completed by NCA economists shows that coal recovered by surface mining made up 44 per cent of the nation's total bituminous and lignite coal production in 1970, and three fourths of this surface-mined coal went to electric utilities.

78 "It should be clearly understood that many major electric utilities would be in bad shape for fuel supplies if there were to be a serious interruption in surface mine production," Mr. Bagge said. "It is not stretching the facts in any way to say that without coal from surface mines, brownouts and even blackouts would be inevitable in many heavily populated areas."

78 The NCA study of coal distribution from surface mines was made in preparation for hearings before the Mines and Mining Subcommittee of the House Interior Committee next week on proposals for Federal regulation of strip mining. Mr. Bagge reiterated that the Association he heads is not opposed to legislation requiring surface-mine operators to meet federal standards in land reclamation, but wants to leave the primary job of developing specific regulations to the states because of variations in climate and typography.

{79} "We recognize that federal standards are needed," Mr. Bagge said, "but the study just completed by our staff shows how utterly ridiculous it would be for Congress to give serious consideration to prohibiting surface mining altogether, as some members of Congress have advocated, especially since the technology exists to achieve effective reclamation."

79 Mr. Bagge made public these results of the study:

79 1. Surface-mined coal production totaled 264 million tons in 1970, or 44 per cent of the total 602.9 million tons of bituminous and lignite coal production.

79 2. Approximately 198 million tons - 75 per cent - of the 264 million tons produced by the surface mining method went to U.S. electric utilities for

power production.This 198 million tons amounted to 60 per cent of total shipments of 331 million tons to the electric utilities in 1970 from all bituminous and lignite coal mines.

79 3. The 198 million tons of surface-mined coal is the equivalent of some 431.8 billion kilowatt hours of electricity. This would represent 28.2 per cent of total electric energy production of 1,529.6 billion kilowatt hours in 1970.Surfacemined coal was 23 per cent higher in 1970 than in 1969, while underground production decreased 2.4 per cent in 1970 compared with 1969. Further increases in surface mine production in 1971 are indicated.

79 4. The 431.8 billion kilowatt hours also is the equivalent of the output of some 62 nuclear generation plants of 1,000 megawatts each, operating at 80 per cent of plant capacity. The 198 million tons of surface-mined coal is the equivalent of 33.7 per cent of the 1,282.3 billion kilowatt hours produced by all fuels, including nuclear power.

79 5. The 431.8 billion kilowatt hours of electricity is approximately the same as the total 1970 generation of electricity in the New England, South Atlantic and East South Central census regions (18 states and the District of Columbia).

{80} Mr. Bagge said that 264 underground mines of one million tons annual capacity each would be required to produce the coal that came from surface mines in 1970. The capital cost of 264 underground mines would be from $3. .2 to $3 .7 billions, Mr. Bagge said, and the time required to build them would be a minimum of three to five years - if the capital and the manpower were available.

80 Underground mines employed some 100,500 men in 1970, compared with 24,800 in surface mines. It would cost an additional $5 00 million to produce underground the coal that came from surface mines in 1970, Mr. Bagge said.

SELECTED READINGS

NATURAL RESOURCES AND ENERGY REQUIREMENTS

NATIONAL COAL ASSOCIATION COAL BUILDING WASHINGTON, D.C. 20036

81 FACT SHEET ON U.S. SURFACE-MINED COAL IN 1970

81 1. In 1970, surface-mined coal production totaled 264.1 million tons, or some 44 percent of the total of 602.9 million tons of bituminous and lignite coal production.

81 2. The 1970 production of 164.1 million tons from surface mines was up 50.8 million tons, or 23.8 percent over the 1969 production of 213.4 million

tons. The 1970 production of 338.8 million tons from deep mines was down 8.3 million tons, or 2.4 percent, from the 1969 level of 347.1 million tons.

81 3. Approximately 198,015,000 tons, or some 75 percent of the 264.1 million tons of surface-mined coal produced in 1970, were shipped to U.S. steam-electric utilities.

81 4. The 198 million tons amounted to 59.8 percent of some 331.4 million tons of 1970 bituminous coal and lignite production shipped to U.S. electric utilities.

81 5. The 198 million tons of surface-mined coal shipped to the utilities represents the equivalent of some 431.8 billion kilowatt-hours of electricity which, when compared with the actual 1970 experience, would amount to:

81 a. 28.2 percent of total electric energy production of 1,529.6 billion kwhrs.

81 b. 34.3 percent of 1,259.5 billion kwhrs produced by fossil fuels (excludes hydro and nuclear).

81 c. 33.7 percent of 1,282.3 billion kwhrs produced by all fuels, including nuclear power.

81 6. The estimated 431.8 billion kwhrs of generation from surface-mined coal closely approximates the total 1970 generation of electricity in the New England, South Atlantic and East South Central Census Regions (18 states and the District of Columbia).

81 7. The estimated 431.8 billion kwhrs generation from surface-mined coal is the equivalent of the output of some 62 nuclear generation plants of 1,000 MW capacity each, operating at 80 percent of plant capacity.

81 8. In barrels of oil equivalent (converted on basis of 24 million Btu/ton of coal and 6.3 million Btu/bbl of oil):

{82} a. 198 million tons of surface-mined coal equals some 752.5 million bbls of imported oil valued at $2.3 billion, on basis of $3 per bbl.

82 b. 264.1 million tons of surface-mined coal equals some 1,003.7 million bbls of oil valued at over $3 billion.

82 9.Some 264 deep mines (of 1 million tons annual capacity) would be required to produce the 264.1 million tons of coal produced by surface mines in

1970.

82 10. The capitablization cost of 264 new deep mines would range from some $3.2 billion to $3.7 billion ($1 2 to $14 per ton of annual capacity).

82 a. It requires approximately 3 to 5 years for a new deep mine to reach full production.

82 11. In 1970 the approximate number of workers at bituminous coal and lignite mines (excluding mill workers) was: Deep mines, 100,500; surface mines, 24,800. (Preliminary data from Office of Accident Analysis, U.S. Bureau of Mines.)

82 12. Underground production of bituminous and lignite coal in 1970 totaled 338,788,000 tons. (338,788,000 tons divided by 100,500 average men working daily (excluding mill workers) equals 3,371 tons per man per year.)

82 13. Some 78,358 deep mine workers (excluding mill workers) would be required to produce 264.1 million tons of coal (on basis of 1970 experience).

82 14. Assuming that all surface mine workers (24,800) would accept employment at deep mines, an additional 53,558 miners would be required to produce 264.1 million tons of coal.

82 15. On a 1970 basis, the estimated wages and salaries (including vacation and holiday pay) of mine production workers (including supervisors and on-site office workers and excluding mill workers) required to produce 264.1 million tons of coal would be:

82 a. Deep mines: $745 million

82 b. Surface mines: $248 million

82 16. On basis of Item 15, it would cost an additional $4 97 million in wages and salaries to produce the 264.1 million tons (of surface-mined coal) at deep mines. (Increased cost of some $1.88 per ton in additional) wage and salary expense.)

{83} [From Field & Stream, August 1971]

83 LET'S LOOK TOWARD AN EARLY END OF STRIP MINING

83 (By Richard Starnes)

83 URIAH HEEP is literature's preeminent hypocrite - a meaching, unctuous dissembler, a hand-washer who pretends to be a forthright and upstanding guy but who is really a crook and a moral leper. It may seem more than a bit strange to start off a piece about TVA and the strip miners by alluding to old Uriah, but in fact the Tennessee Valley Authority and Dickens' celebrated rogue have certain startling similarities.

83 Both pretend to piety and good works, and both are double-dyed villians. In short, both are terrible hypocrites.

83 In all the calamitous national scandal of strip mining, there is a gaudy array of malefactors, to be sure. But none quite touches TVA for the wicked role it has played. It is the worst not only because it is by far the world's largest user of stripmined coal, but perhaps even more because it traditionally pretends to be on the side of the conservationist, ecologically-right-with-God angels.

83 I know of no worthwhile estimate of how many thousands upon thousands of hillside acres have been destroyed to fill TVA's insatiable furnaces. But its current "burn" is on the order of 31 million tons of coal a year - all of it strip mined.

83 And before we get into TVA's self-serving arguments for the defense, let us finally agree on one central fact about strip mining: There is no effective means of reclaiming or restoring the typical strip-mine site.

83 Except for a handful of essentially phony showpiece restorations, the prevailing custom among strip miners is to leave the ghastly scars in the earth pretty much the way they were when the last truckload of coal was removed - easy prey to erosion and to acid water runoffs that poison whole watersheds.

83 "Like putting lipstick on a corpose," is how current strip-mine reclamation efforts were described to me on a recent trip to West Virginia.

83 Look at the figures. The Bureau of Mines in 1965 said that over 1.3 million acres in the United States had been stripped by coal operators. Now the Bureau estimates that over the last six years another 480,000 acres have been stripped - but that only 56,000 acres have been reclaimed. It's a mighty dismal picture.

83 Until 1965 TVA didn't even pay lip service to restoring the land that had been destroyed to get it cheap coal. Then, in response to the outraged howls of a few journalists (of whom I am proud to say I was one) TVA grudgingly wrote a restoration clause into its procurement contracts. It was a sick joke then and it is a sick joke now, for most authorities at long last have agreed that even if good will and a willingness to pay the price are present, it just isn't

possible to undo the horrible affronts to nature that are routinely committed by the strip miners.

83 But TVA's propaganda apparatus is almost as considerable as its steam plants, and for a time about 1965 it got away with pointing to the come-lately reclamation clause in its coal contracts. Look a-here, their flacks would declaim, we got it writ into our contracts. Don't you pay no mind to what some roughneck reporter is writing.

83 Weary and angered by it all, three environmental organizations recently filed a Federal lawsuit accusing TVA of ignoring environmental protection standards in contracting for strip-mined coal.They were joined by Harry Caudill, a Kentucky lawyer and author, who has fought a hard battle to save the mountains he loves.

83 Citing "the systematic destruction of mountains and countryside," the suit asked the U.S. District Court for the Southern District of New York to find that TVA had "blatantly" broken the National Environmental Policy Act of 1969.

83 There is no denying that TVA reservoirs have provided a lot of recreation over the years. Now, however, even some of the agency's best friends are scratching their heads in disillusionment at the overpowering environmental damage it has caused.

{84} TVA has run the whole gamut of arguments to defend its role in strip mining. But all of them collapse because ultimately people go and look at the land still being ruined despite the 1965 reclamation clause. So now, after decades of oleaginous writhing that would have done credit to old Uriah himself, the great stripmine conspiracy has arrived at its last line of defense:

84 The nation, goes the ultimate argument, is deep in the throes of an energy crisis (that is to say a shortage of electricity) and hence any evil can be condoned if it produces more coal for the steam plants of TVA and other power companies.

84 I think it is possible to demonstrate that the energy crisis is largely boloney, a sausage having the aroma of fine old gorgonzola that has been contrived by the philosophers of strip mining and off-shore oil drilling, the oil import quota entrepreneurs, and other such high-minded chaps.

84 But, temporarily and for the sake of argument only, let us assume that there is an energy crisis, or that there soon will be one. It seems to me that the answer to the profligately wanton use of electricity for which America is

noted is to reduce the amount of electricity we use - and often waste - not to destroy the very earth we live on in an attempt to meet ever-expanding demands for power.

84 No other people are as hooked on bright lights as we are. Big cities like London do have their bright spots but they do not have the endless miles of garish neon highways spoking away in every direction. Outside this country, it is rare to find homes heated by electricity. The household appliances that Americans take for granted are still novelties to most of mankind. And even if we do continue to give the strip miners carte blanche to rape our mountains, can we meet the insatiable demand for electrical energy that will be heard if our present habits carry over to a population that some soothsayers claim will double in three or four decades?

84 Of course not.Sooner or later the nation will have to adopt a more rational energy policy. Unless this is done, we will likely have no real means of defending the land against the depredations of the strippers.

84 But those steps, in my judgment, lie somewhere in the future. For now it should be sufficient to show that the energy crisis is a cynical ploy that is being attempted to serve wicked ends.

84 The fact is that we are still a coal exporting nation, particularly to Japan. I am indebted to one of TVA's prime propaganda organs, its quarterly (mailed free at taxpayers expense, by the way) called Tennessee Valley Perspective, for informing me that Tennessee Consolidated Coal Co. has contracted to sell up to a million tons of coal mined in Marion, Grundy and Sequatchie counties to the Japanese metallurgical industry. There is also at least one $1.6 million contract to ship West Virginia coal to Japan.

84 At long last, constructive action may be forthcoming from Washington. In late 1969 Congress forced coal men for the first time to provide honestly for the safety and health of their workers. Now at least half a dozen bills have been introduced to deal with the strip-mining scourge. The toughest of them all, and very possibly the best, sponsored by Representative Ken Hechler, of West Virginia, has attracted more than sixty-five co-sponsors in the House and is picking up support in the Senate as well.

84 Hechler's bill, HR 4556, is unique. It would ban all strip mining within six months. Strong medicine? Sure, but that's what is called for to save the patient. As the determined West Virginia legislator - the environmental "doctor" of the case - aptly analyzes the disease: "Billions of tons of valuable topsoil, trees, rocks, the habitat for wildlife and the hills themselves are being chewed and churned up because it's so cheap to make a quick killing when

you can pass the environmental costs on to future generations."

{85} The blunt fact is that strip mining is an earth cancer that is spreading at an ever faster rate. It can't be cured by cosmetics any more than it can be hidden any longer by lies. It needs to be stopped entirely, and those of use who want to stop it had better want to hard enough to ask our people in the Congress where they stand. The good life you save will be your own.

{86} [From Massachusetts Audubon Newsletter, April 1971]

86 SOCLAL COSTS OF ENERGY

86 There are few issues that are more likely to divide the industrial community from those whose primary concern is environmental quality than the problems associated with the increasing production of energy and goods in the U.S. today. The problem is summarized in the recent report of the National Goals Research Staff:

86 America appears to be at a point of profound change, freguently characterized as that from an industrial society to a "post industrical society" - from a sociey in which production of goods was of primary concern to one dominated more by services and the generation and use of new knowledge. n1

86 n1. Toward Balanced Growth: Ouantity with Ouality, Report of the National Goals Research Staff, 1970, p. 33.

86 We shall discuss some aspects of this problem, namely, the factors that encourage wasteful use of energy, and some of the social and environmental costs that should be included, but presently are not, in the total cost of energy.

86 The Role of Energy

86 It has been stated that availability of large amounts of concentrated energy has been a most important factor in the evolution of modern industrial society. As per capita consumption of energy has grown over the past two centuries so has the Gross National Product.

86 Growth in production and services seems to be, at least psychologically, one of the cornerstones of our economic system. It is therefore not surprising to find that the growth of energy production has been promoted not only by the federal government, but also by state and local governments. At a recent meeting of the American Institute of Chemical Engineers, Mr. Robert Jaske, a leading engineer in the area of heat rejection problems, summarized the situation:

86 In the long run, the solution [to the heat rejection problems] may lie in a complete reevaluation of the use of energy . . . the time has come for serious examination of national energy policy on a broad front. Such an examination will discover early that the primary motivating force in the expansion of the use of energy has been the subsidization policy of the federal government. n2

86 n2. Jaske, R.T., Fletcher, J.F., Wise, K.R., "A National Estimate of Public and Industrial Heat Rejection Reguirements by Decades through the year 2000 AD," BNWL-SA-3052, 67th National Meeting of the American Institute of Chemical Engineers, Atlanta, Georgia, February 17, 1970, p. 21.

86 A similar view is expressed in the recent report Electric Power and the Environment, prepared by the Energy Policy Staff of the Office of Science and Technology:

86 There are numerous statutes enacted over the past few decades which expressly state a U.S. government policy of promoting low energy costs. This policy affects not only the pricing of electricity generated by federally owned entities but the policies of federal regulatory agencies and recipients of federal loans as well. These policies should be reconsidered to assure that they are best adapted to the future needs of the Nation. n3

86 n3. Electric Power and the Environment, A report sponsored by the Energy Policy Staff, Office of Science and Technology, August, 1970, p. 48.

86 Nor are the policies of low energy rates the only mechanisms used to subsidize cheap energy. By failing to enforce air and water pollution regulations both federal and state governments are indirectly promoting the growth of consumption of energy and goods. Such growth occurs, however, at the cost of both the health of industrial workers and those persons living near major polluters, and the gradual deterioration of the quality of life. There is, moreover, a feedback effect at work: the more that pollution is allowed in the production of goods the faster the goods will deteriorate and therefore have to be replaced by new ones. Pollution then favors both "conspicuous consumption" and "accelerated obsolescence."

86 Social Costs of Energy Production

86 One of the major reasons that pollution has been allowed to advance to its present state is that its harmful effect on man, vegetation, and materials

are not clearly recognized by the public. Ralph Nader has characterized air pollution as a form of "subtle violence," meaning that it is administered over a long period, frequently at moderate doses. Regrettably too many of us have unconsciously "adapted" to these levels of pollution. The effects are not directly associated in space and time with the sources, and as a result both the public and our governments tend to recognize only the benefits of energy consumption and not its costs.

86 Nor are all the environmental costs of pollution known to either scientists or economists. In fact, few economists seem to have taken interest in the problem, and then at the risk of being chastised by colleagues for making assumptions that may not be entirely realistic. As a result almost all economic estimates of environmental damage are characterized by their authors as being "conservative" and probably vastly underestimating the true costs.

86 For the most part no economic price tag can be placed on the emerging manmade effects on the global environment. For example with the atmosphere, global trends are imperfectly understood. There always have been naturally occuring changes in global climate which complicate the analysis of man's impact. Volcanoes, in particular, can cause these changes rather quickly. n4 What is of concern now is that man-made activities, particularly those associated with energy production through combustion, are of sufficient magnitude to explain presently occurring trends. n5 If future research shows this definitely to be the case we shall be faced with a new sort of "costbenefit" analysis. What price shall we place on the loss of lands to deserts or to the melting of ice caps resulting from a rise in global temperature? Or, conversely, would we rather try to calculate the cost of a drop in the earth's temperature from failing to control particulate air pollution:

86 As civilization continues to contaminate the atmosphere, the number of small, dust-like particulate pollutants in the air steadily increases. Calculations done at the Environmental Science Services Administration (ESSA) indicate this steady increase of particulate matter in the atmosphere may ultimately create eternal winter on earth. n6

86 n4.Man's Impact on the Global Environment, Report of the Study of Critical Environmental Problems, 1970, pp. 16, 44, 57-58.

86 n5. Gordon J. F. MacDonald, "The Modification of Planet Earth by Man," Technology Review, October/November, 1669, p. 27.

86 n6. U.S. Department of Commerce News Release, ESSA 70-17-54, March 4, 1970.

86 The assessment of the costs and benefits of possible global changes in the environment is beyond the scope of this paper. We have tried to stress that such effects are real and they will have to be considered in the not too distant

future.

86 There are other, more tangible and more apparent, undesirable side effects of energy production which are beginning to receive serious attention because of the increase in public concern over environmental quality. The extent to which the public will support the financial programs needed to control these unwanted or second-order effects depends on how the costs are presented.

If they are viewed in isolation, with no reference to the other legitimate costs of energy such as fuel transportation and refining, they will be accepted within a narrow framework of "improving the environment" or perhaps "preventing pollution." It would be far preferable to accept these costs as part of the overall price of living in a highly technological society while at the same time maintaining a viable environment.

87 Social Costs of Energy Production from Fossil Fuels

87 At present almost 96 percent of the energy demands of the United States are met through burning fossil fuels. Nuclear power which is used for the generation of electricity accounts for about 1 percent of the U.S. energy production. However, this source is predicted to grow during the next ten years at an average annual exponential rate of about 32 percent (which means that the total nuclear capacity must be doubled every 2.u years.) At this growth rate, nuclear power will be providing about 22 percent of all electricity by 1980 and perhaps as much as 60 percent by the year 2000.

87 Electricity and Fossil Fuels

87 We shall restrict ourselves to considerations affecting energy production from coal and oil. Natural gas, the third major fossil fuel, creates virtually no particulate or sulfur oxide problems and except for possible nitric oxide production (a problem common to all forms of combustion) can be considered pollution free. Gas is the scarcest of the three fossil fuels though this situation may change as technigues for converting coal to liguid and gaseous forms are perfected.

87 Some Side Effects of Coal Production

87 About 60 percent of the coal mined each year is used to generate electricity. And nowhere are the social costs of power production more evident that in the human misery experienced by soft coal miners in the United States. In effect, the nation's electricity and industrial production are subsidized by sacrificing the health and lives of the country's 150,000 mine workers.

87 It has been known for some time that coal mining is the most dangerous industrial occupation in the country. As a result of a chronic neglect to provide safe working conditions, one of every 300 mine workers dies each year and one in every 30 is severely injured. Such accident and death rates could be drastically reduced, as demonstrated by the much safer conditions in European mines.

87 In addition to high death rates from accidents coal miners in the U.S. also are faced with the almost certain prospect of irreversible lung damage from pneumoconiosis, or as it is called, "black lung disease." This disease results from the prolonged breathing of dust particles and, according to one theory, leads to the destruction or impairment of the lungs' tiny blood vessels, thus inhibiting the transfer of oxygen to the blood. The Surgeon General of the U.S. has estimated that over 100,000 miners suffer from black lung disease, which means that most miners have it and that large numbers probably die from it. Yet through what only can be described as a conspiracy involving coal mine operators, "company doctors," union officials and government officials, few miners have been compensated for their destroyed health.

87 [See Illustration in Original]

87 It is possible that some of the costs presently borne by coal miners will be "internalized" or passed on to the consumer because of the Federal Coal Mine Safety Act of 1969. The act reguires many new safety measures and places limits on the concentrations of coal dust in mines. According to a Bureau of Mines analysis the costs of the new safety and health measures could add up to 10 percent to the cost of coal. That is, for about 40~ a ton much of this human suffering and death could be avoided.

87 Some Social Costs of Strip Mining

87 In 1969 there were about 560 million tons of coal mined in the U.S. valued at more that $2 .5 billion. About one-third of this coal was extracted through "strip mining." Strip mining, as it is presently practiced, produces coal at about half the cost of deep underground mining. This savings in cost, coupled with the great simplicity of the process, has led to a rapid increase in its use over the past ten to fifteen years. As with underground mining, however, there are enormous social costs involved. These costs, in the form of ruined land, are presently not being paid by either the producers or consumers of coal. In all likelihood it will be the federal government that will have to assume the costs of restoring the land, where it is possible, to some semblance of normalcy.

87 The amount of land subjected to strip mining in the U.S. was estmated, in

1965, at more than 3.2 million acres, an area almost two-thirds the size of Massachusetts. About 41 percent of this land, or about 1.3 million acres was strip mined for coal. As of 1965 more than 2 million acres of all the land blighted by strip mining had not been restored in any significant way. The cost for a minimal reclamation program for this land was estimated in 1968 at $757 million.

87 The devastation from strip mining could be avoided by properly restoring the land as soon as it is mined. In Ohio there is a model area of more than 100,000 acres that is one of the more popular recreational sites in the state. There are 250 ponds and lakes, wooded areas, public campgrounds, picnic tables, wells, and fireplaces all provided free to the public as a result of a joint venture between the Ohio Power Company and the Ohio Division of Wildlife.

87 One can justly ask why such programs are not more common. The answer, as with mine safety, seems to be one of economics: either profits of the coal producers coal would be increased. Or both. As indicated earlier electric utilities account for 60 percent of the coal consumed in the U.S. According to H. M. Caudill, a Kentucky attorney and vocal critic of strip mining, the TVA is the "nation's biggest coal consumer and its purchasing policies have set the pace for the market elsewhere. n7 Mr. Caudill argues that by insisting on rock bottom coal prices for its generating plants TVA has provided a strong incentive for aggressive strip mining. Cheap electricity, he argues, is promoted at the expense of destroyed land.

87 n7. Harry M. Caudill, "Paradise is Stripped," New York Times Magazine, March 13, 1966.

87 The Hidden Costs of Oil Products

87 Petroleum products consitute the largest source of energy in the country and presently supply about 43 percent of our total energy needs. Nevertheless they account for only 12 percent of the electricity generated.

87 Present World production of oil is about 1.8 billion metric tons. About .1 percent of this oil, 2 million metric tons, is introduced into the oceans each year. According to the recent MIT report, Man's Impact on the Global Environment, at least 90 percent of this oil "originates in the normal operations of oil-carrying tankers, other ships, refineries, petrochemical plants, and submarine oil wells; from disposal of spent lubricants and othe industrial and automotive oils; and by fallout of airborne hydrocarbons emitted by motor vehicles and industry . . . " n8

{88} n8. Man's Impact on the Global Environment, p. 139.

88 The effects on the oceans of this much oil are discussed in the MIT report. They include the poisoning of clams, oysters, scallops, fish and marine birds; and the possible long-term devastation of marine life from mass destruction of juvenile forms and of the food sources of higher species. Dr. Max Blumer of the Woods Hole Oceanographic Institution and one of the leading authorities on oil pollution, has expressed the fear that there may develop an "accumulation in human food of long-term poisons derived from crude oil, for instance, of carcinogenic compounds." n9 He is concerned that through oil pollution of the seas "we may eventually destroy the yield and the value of the food which we hope to recover from the sea." n10

88 n9. Max Blumer, "Oil Pollution of the Ocean" in Oil on the Sea, Plenum Press, 1969, p. 10.

88 n10. Ibid., p. 12.

88 About 500,000 tons of the oil reaching the oceans arise from tankers that routinely pump oily waters directly from their bilges into the oceans. These losses could be cut by 99 per cent by following a relatively simple procedure known as "Load On Top." About 80 percent of the world's tankers now follow this procedure. The 20 per cent that do not - because of small costs and inconveniences - account for 95 percent of all oil losses from tankers.

88 It has been estimated that another 500,000 tons of oil reach the oceans from engine crankcases. At the present time it is uneconomical to recover or collect these wastes.As a result the oceans pay the price. The MIT report suggests that an automobile tax be added to the cost of oil in an effort to adjust the economics of the situation by placing the costs of disposing of oil on the consumer where they belong.

88 Another 400,000 tons of oil pollution results from off-shore oil well production and refinery wastes. It is clear that these wastes could be reduced if they had to be and that the added costs of gasoline and oil should be passed on to the users of petroleum products.

88 Other Costs

88 We have discussed some of the costs associated with the extraction and delivery of fossil fuels. There are other costs which result from the burning of these fuels. Among these are the release of large quantities of SO_2 and

particulates with consequent damage to vegetation, metals, buildings, automobiles, and, most importantly, human health. It could cost upwards of 2.5

billion just to install scrubbing equipment on all the fossil-fuel power plants in the country. There would of course be additional costs in operating this equipment, adding perhaps 5 percent to 15 percent to the cost of electricity. The costs of controlling the thermal pollution of rivers and lakes also could add a few per cent to the cost of electricity, depending on whether cooling ponds or towers are used.

88 We have not attempted to construct a balance sheet for the costs and benefits of reducing the environmental destruction that presently results from using fossil calculation seriously could be undertaken. There are too many intangibles in the form of aesthetics and unknown risks. For example, there are a growing number of biologists who believe that what we now term "aesthetics" may be more important biologically than we generally think.More research is needed to determine the importance of "aesthetic considerations" in the development and maintenance of community mental health. On the other hand the permanent impairment of oceanic or atmospheric functions should be avoided at all costs. Since we do not now understand the relationships between our activities and their long-term effects the only prudent policy is to minimize the risks. In general this means applying all available technology to reduce the effects of pollution.

88 Social Costs of Energy Production from Nuclear Sources

88 In the United States the AFC has the responsibility for development of nuclear energy for peaceful purposes. The primary emphasis in nuclear power production has been on commercial development of light water reactors - the kind which are currently being constructed in the United States. According to a recent article in Fortune, the AEC has spent more than $2 billion in federal funds so far to bring nuclear power to commercial status. This program has not been developed without criticism, and as with fossil fuel power plants, the roots of the unhappiness can be ultimately traced to economic considerations.

88 [See Illustration in Original]

88 To see how the economics of nuclear power production can generate tragic social costs one need only consider the very high incidence of lung cancer that occurs among underground uranium miners in the U.S. It was known in the country in the 1940s that lung cancer was occurring frequently among the miners in the Schneeberg mines of Saxony and the Joachimsthal mines of Bohemia. According to Dr. Karl Z. Morgan, director of the Health Physics Division of Oak Ridge National Laboratory,

88 . . . In spite of these centuries of unhappy human experience from exposure of miners to uranium ores, the Federal Radiation Council did not take the initiative in calling attention to the many miners in the Colorado plateau who were engaged in mining operations where the levels of exposure probably were

equal to or greater than those that led to early tragic experiences, and in any case they often were 10 to 100 times the levels set by ICRP [International Commission on Radiological Protection]. Even after the seriousness of this problem was brought into focus by the excellent work of Holaday . . . and others with the Public Health Service, the FRC was slow in recognizing the problem and taking appropriate action. Finally, after long delays, the FRC recommended what amounted to one working level, WL, which was three times the 3WL recommended

by the Department of Labor. n11

88 n11. Morgan, K.Z., Struxness, E.G., "Criteria for the Control of Radioactive Effluents," SM-146/10, Symposium on Environmental Aspects of Nuclear Power Stations, August 10-14, 1970, p. 26.

88 As Sheldon Novick summarized the situation,

88 Although the AEC published its first price schedule for uranium in 1948, it was not until July of 1967 that a safety standard of any sort for uranium miners was enforceable. All this despite the record of disastrous experience in European uranium mines. A very similar pattern can be seen in the history of radioactive water pollution from uranium mines. n12

88 n12. Sheldon Novick, The Careless Atom (Boston, 1969), p. 132.

88 According to Mr. R. L. Faulkner, director of the AEC's Division of Raw Materials, a decision is pending to lower the permitted exposure by 66 percent from the present permitted level of 1 WL.

{89} Among the factors to be considered in the decision are "radiation concentration and exposure levels and control, health and medical aspects, economic impact and concentration exposure measurement techniques and equipment." n13 It certainly would compound a past tragedy if the presently permitted levels are sustained because of the economic impact that safer levels would have on electricity rates.

89 n13 Remarks by R. L. Faulkner before the Uranium Committee of the American Mining Congress, San Francisco, October 19, 1969. p. 7.

89 The major area of public concern with respect to nuclear power involves, of course, the radiation exposures from reactors. We have here an almost perfect example of the difficulties that arise in making "cost-benefit" judgments in the large scale application of technology. To begin, the exact biological effects on large populations from receiving small doses of radiation are now being hotly disputed. The estimates range from negligible (by the AEC)

to disastrous (by scientists such as Gofman, Tamplin and Pauling). The situation is unique in that actual numerical estimates are being made on the number of deaths that will occur from the routine operations of reactors. The dispute on the size of the numbers involved has focused public attention on the real central question: how much monetary value will we assign to human life for a given technological benefit? Or, stated differently, how do we decide on the extent of an emissions-control program for reactors if the long-term effects of radiation are still unknown?

89 (Interestingly, these same questions must also be asked for the radioactive natural gas that has been recovered in the AEC's Plowshare program. The doses that would be received from using this gas have been estimated to be of the same order as those that would be received by living near the edge of a reactor site.)

89 Conclusion

89 At the beginning we cited the statement of the National Goals Research Staff to the effect that the United States is making a transition from a

productionoriented society to one dominated more by the delivery of services. We would add to their statement the corollary that the country is becoming more concerned with the quality of its existence than with the quantity of goods that it produces. A major factor in this transition from emphasis on quantity to quality will be the internalizing of costs that are now being manifested in the forms of environmental pollution. As pollution is reduced energy and goods will, of course, cost more. As a result we will become less wasteful, less frivolous and less consumption oriented. We shall, in effect, be taking the first steps toward the closedcycle economy that in the long run will have to be reached.

89 Dr. James J. MacKenzie

SELECTED READINGS

ENVIRONMENTAL EFFECTS

98 HYDROLOGIC EFFECTS OF STRIP MINING WEST OF APPALACHIA

98 (Although undesirable side effects can result from strip mining, such operations can also prove to be hydrologically beneficial. West of Appalachia, strip-mined land can be managed to diminish floods, increase low flow and become a significant source of water)

98 (By D. J. Cederstrom, Hydrologist, U.S. Geological Survey)

98 In 1966, the author was one member of a group representing various disciplines, headed by the U.S. Bureau of Mines, whose task it was to assess the effects of strip mining on the environment in areas outside of Appalachia. The author's specific task was to note hydrologic effects of these strip-mining operations. The overall results of these inspection trips have been given in a Department of the Interior publication entitled, "Surface Mining and Our Environment." n1

98 n1 A Special Report to the Nation, U.S. Department of the Interior, Washington, D.C., 1967.

98 The hydrologic effects of strip mining noted west of Appalachia tend to be beneficial to the environment, or could easily be so in a great many places, although there are places where undesirable or potentially undesirable hydrologic effects were noted.

98 STREAM FLOW GREATER IN STRIP-MINED AREAS

98 At this point, it seems appropriate to consider the effect of surface mining on underground water as observed in Indiana and Illinois. Here on low-lying, gently rolling to almost flat ground, great areas have been torn up and turned upside down. In one of these areas, Don M. Corbett of the Indiana University Water Resources Research Center, found that in October 1964 a stream draining undisturbed ground had a flow of 1900 gpd per square mile, whereas a stream draining a strip-mined area had a flow of 120,000 gpd, that is, about 63 times as much. n2

98 n2 Corbett, D.M. "Water supplied by coal surface mines, Pike County, Indiana," Water Resources Research Center, Report of Investigations No. 1, 1965.

98 Let us see why this interesting difference has come about. Rain falls upon the earth (or snow melts following general warming of a winter climate) at which time a large part of the water received on the surface soaks into the ground and the remainder is shed to streams. Streamflow is at a relatively high stage but in a matter of hours or days the flow begins to decline. Unregulated streams, that is, streams lacking reservoirs in headwater areas, would then dry up completely (until the next rain) were it not for the seepage from the ground. Thus, the sustained low flow or base flow of our streams and rivers consists almost entirely of ground water outflow. During the higher flow periods, ground water, of course, continues to be contributed along with the generally larger volume of overland or direct runoff.

98 RECHARGE CAPACITIES OF EARTH FORMATIONS VARY WIDELY

98 The receptivity, or recharge capacity, of earth formations ranges widely. A square mile of level or gently rolling sandy terrain in the humid East may be expected to receive an average of 1 mgd recharge to the ground-water reservoir. The amount absorbed by the soil cover may be considerably greater but the soil characteristically acts like a blotter in retaining a significant part of the precipitation, after which it is lost as it evaporates or is transpired by the plant and tree cover.

98 About 1 mgd per square mile average recharge may be received by a sandy ground-water reservoir but where the earth material beneath a thin soil cover is rock of low permeability, a large part of the potential recharge water is rejected. Briefly, the soil may quickly become fully saturated if the rock below it cannot accept water readily. Failing to find space, precipitation (or snowmelt) is then rejected by the ground and becomes direct runoff instead of recharge to the ground-water reservoir.

98 The ground-water recharge in an area underlain by thick limestones and interbedded shales is much less than the 1 mgd per square mile noted above. DeBuchananne has estimated that the recharge of limestone terrane in the valley of Virginia is about 1/2 mgd per square mile. n3 Recharge in areas underlain largely by flatlying shale and sandstone beds, according to Wyrick, may be less than 1/3 mgd per square mile. n4 In deeply dissected plateau areas, lateral leakage may be such that much of the recharge is discharged to streams relatively rapidly and hence is not available for streamflow in dry spells.

98 n3 DeBuchananne, G.D. "Ground-water resources of the James, York, and Rappahannock River basins of Virginia west of the Fall Line," U.S. Geological Survey, 1968.

98 n4 Wyrick, G.G. "Ground-water Resources of the Appalachian Region," U.S. Geological Survey, 1968.

{99} MINED LAND HAS GREATER RECHARGE POTENTIAL

99 Obviously, cast ground in a strip-mined area will tend to function as an extremely coarse gravel where the material is largely brittle rock fragments. We might assume that recharge would initially be as much as 2 mgd per square mile but with the slow gain of a true soil cover and a stand of trees or grass, the rate of recharge would decline to something like 1 mgd per square mile. Where the cast ground is shale, the fragmented material is finer and has a larger component of ground up rock. Hence, such ground should be much less

favorable to recharge than cast ground made up of sandstone and limestone.

99 From the point of view of susceptibility to recharge, we may conclude that in the Midwest, cast ground made up of sandstone, limestone and shale is probably at least three times more favorable than those formations in their original undisturbed state.

99 At this point, let us examine the storage potential of cast ground and compare it with naturally occurring earth material. A sized gravel made up of well rounded grains has a void space of about 40 percent. Cast ground, made up of angular fragments, is at best rudely sized and does contain some fines. Hence, the void space in cast ground may be in the nature of 15 to 25 percent of mass.

99 The percentage of void space in consolidated rock is difficult to measure accurately. The voids range from minute pore spaces and openings along bedding planes to gross openings developed by joints and along fracture and fault zones. However, a storage potential of 1 or 2 percent of the rock mass is generally accepted as representative except perhaps for certain limestones riddled with solution openings. Hence, the storage capability of thrown ground may be from 7 to 25 times greater than that ground in an undisturbed condition.

99 PERMEABILITY CONTROLS RATE OF WATER MOVEMENT AND STORAGE

99 With regard to permeability, the measure of rate at which water will be trans mitted through the ground under a unit hydraulic gradient, it will suffice to say that, upon imposing a hydraulic gradient, water should move rather rapidly down the hydraulic gradient through cast ground made up of brittle rock fragments but much less rapidly where the cast ground is largely shale.

99 It is of great importance from a hydrologic point of view to bear in mind that a block of cast ground will function essentially as a unit. With withdrawal or drainage of water from one point, water will begin to flow to that point from throughout the entire mass. In undisturbed ground, a channel or fissure zone may not be connected or may be poorly connected with adjacent channels or fissure zones, in which case the water tends to be compartmented.

99 Let us consider now what overall hydrologic advantages may have been gained in a strip-minded area. First, it must be appreciated that cast ground lying on steep slopes can hardly be thought of as other than detrimental to the hydrology of the area. Recharge is favorable, but water entering such ground will drain from it rather quickly and, depending on the type of ground, might carry a sediment load of harmful proportions. Full saturation of a fine-grained mass on both steep and gentle slopes will favor creep or sliding of the entire mass with various consequences, ranging from undesirable to dangerous to human life.

99 However, when we consider the thousands of square miles of disturbed ground in gently rolling to flat terrain, hydrologic advantages are apparent: 1) The ground will absorb a large volume of precipitation rapidly, 2) storage space is normally present in the disturbed ground (a 50-ft thickness of saturated ground one mile square might hold from 1.56 to 2.60 billion gal of water -

27,878,400 ft2 x 50 ft x 7.48 gal x 15 or 25 percent), and 3) much of the water in storage could be moved with fair rapidity to any point by imposing a hydraulic gradient on the reservoir, either by lowering the outlet of this underground reservoir or by pumping wells.

{100} CAST GROUND CAN AID RUNOFF CONTROL

100 To manage or to foresee management of a block of cast ground as a hydrologic resource, certain conditions are pertinent. If the purpose is to regulate the flow of adjacent streams the block should drain rather slowly. It may do so if the permeability of the material is only moderate and the area of discharge to the stream is small. If the outlet is too small or at too high a level relative to the depth of the block of cast ground, considerable dead storage of water will result. Dead storage might be avoided by trenching from the appropriate stream level to the base of the cast ground reservoir. An ideal situation would be a dam, of a sort across the drainage face or channel, the outlet of which could be controlled as needed.

100 Thrown ground can function favorably in stream regulation, as Corbett noted, n2 if it happens to be situated in the right place. A better approach would be a hydrologic appraisal followed by construction of suitable structures that would 1) insure drainage of the block of cast ground at times of low flow or no flow of the streams and, having this lowered the water level in the tract of distrubed ground, and 2) provide storage space for receiving and retaining excessive precipitation normally resulting in floods.

100 n2 Corbett. D.M. "Water supplied by coal surface mines, Pike County, Indiana," Water Resources Research Center, Report of Investigations No. 1, 1965.

100 Wells ending in undisturbed hard rock in the Indiana area generally have very poor yields except where they may be overlain by saturated sandy material. About 20 gpm is considered a high yield in a well finished in limestone in Indiana and the average yield is much less. Wells constructed in cast ground should do much better. Where the cast ground is brittle sandstone or limestone, some large yields should be possible from wells constructed in them. Where the saturated thickness is 40 ft or so, wells in such ground might yield significantly more than 100 gpm. Further, the storage and recharge

characteristics of the cast ground, as noted above, are such that wells in it will continue to supply ample water in times of protracted drought.

100 Where the cast material is largely true shale, the hydrologic characteristics are much less favorable. Storage characteristics would be relatively favorable but more difficulty would be experienced in obtaining high-yield wells. Slaty, limy, or sandy shale would function better than true shale as an aquifer.

100 It must be emphasized that the beneficial hydrologic effects noted are most noteworthy in areas where acidic waters are not generated. Although acidic stream water is undesirable or harmful, it may still be said that where cast ground acts to lessen potentially harmful flood flows, a benefit has resulted. Maintenance of a flow of more or less acidic water in periods of drought as opposed to no flow can hardly be considered helpful.

100 EFFORTS MADE TO CONTROL ACIDIC WATER

100 In the Midwest the problem of acidic water is seemingly much less acute than in Appalachia. In part, this may be due to the fact that the topography is gentle and pyritic material is generally less exposed to oxygenated waters. Very real efforts were being made at the mines visited to control the production of acidic waters and their flow to the streams. In one place, at least, acidic water was chemically neutralized before being allowed to drain out of the mine area.

100 Some success attends efforts to bury pyritic material beneath inert fill or to confine it to deeper furrows where it is overlain by many feet of deoxygenated water. However, in the latter situation, torrential rains will tend to stir the water as a result of which oxygenated water will come into contact with pyritic material. Two approaches to that problem suggest themselves. Where pyritic material lies at the bottom of a water-filled furrow, spreading a layer of clay or finely ground shale upon it should do much to negate the effect of occasional circulation of the overlying water. The other thought is that during mining operations, bottom acid-forming earth material should be dumped as low on the side of the last (active) ridge as possible rather than on the crest, where much or most of that material would roll to the furrow bottom. There it will ordinarily be covered when the succeeding ridge is built. This practice is followed in at least one mine. Such action should ameliorate the ill effects of acid waters upon the hydrologic environment.

100 Some of the present problems are carryovers from several decades ago. These include drainage from abandoned gob (waste) piles at sites of old operations and, to some extent, from the practice of local highway departments

of using gob as road-building material. Road building with gob seems to be no longer practiced. However, neutralization of the huge abandoned gob heaps that are found from place to place in the Midwest may not be accomplished in the near future. Some control of acid drainage presumably could be achieved by restricting circulation of meteoric or ground waters through the heaps.

{101} LAKES HAVE BEEN CREATED

101 There are other hydrologic benefits from strip mining in Midwest fields where thousands of small lakes have been created in the resultant ridge and furrow topography. With specific respect to water supply, these lakes as such consitute a reservoir of significant magnitude. Further, upon pumping from lakes, saturated bank material, made up of moderately permeable shale fragments or highly permeable sandstone and limestone fragments, will contribute water to the lakes. In this sense, then, the lakes may be thought of as a series of dug wells in which considerable storage is present in each.

101 The ponds and lakes created by disturbed ground are commonly hydrologic benefits in the sense of improvement of the functioning of the hydrologic cycle and also in a secondary sense in that the ponds and lakes are, or can be, distinct assets with reference to use by humans and wildlife. Great stretches of the midwestern landscape are pleasant but, at least to the writer, somewhat monotonous. The lakes and ponds left after stripping provide not only scenic variation, but desirable housing sites, fishing, swimming and boating areas, duck ponds, and wildlife refuges. The general setting of the tracts set aside for these purposes ranges from lakes in furrows between raw ridges (where fishing is said to be good) to handsomely landscaped rolling ground with shade tree, beaches, clubhouse facilities or fine homes around small lakes or sinuous waterways.

101 I can't begin to evaluate the hydrologic benefit from a lake 80 miles long and a mile or two wide that will someday form in the Mesabi country. The eventual cessaton of mining there and the filling of this tremendous pit will hardly come in the time of most of us living today. This question is then left unanswered except to note that unpolluted lakes are becoming scarcer every day, and this future lake may fill a real need in an otherwise contaminated world.

101 WATER-RETENTION STRUCTURES CAN PREVENT FLOODS

101 The phosphate mines in semi-arid Wyoming present an interesting situation. Here, long furrows are made high on mountain slopes and granular overburden material is disposed of on the lower slopes. One is reminded of the water-retention structures on the slopes above San Bernadino Calif. There, structures are built to intercept the flow of temporary torrential streams down

the nearby mountains. Water flows into an unlined catchment, fills and overflows, is led to lower catchment, and so on. Meanwhile, in filling and passing from one catchment to another, the water has time to infiltrate the ground with the net result that San Bernadino is not only protected from flood damage but has also salvaged water that might be lost to an adjacent county or to the sea.

101 Something similar might be accomplished at small cost in the phosphate area referred to, and perhaps at some huge open-pit mines elsewhere in the West and Southwest, by judicious planning of spoil disposal. There seems to be little need for inducing additional recharge in the particular areas visited by the writer, although the idea is valid enough. Catchment structures of the type outlined above might be justified where flash floods are a local problem and, in any event, retention structures would minimize or eliminate the sediment load of temporary streams flowing through or from the disposal area.

101 GROUND WATER CONTAMINATION NOT A MAJOR PROBLEM

101 Contamination of ground-water supplies has occurred in consequence of leaching of pyritic copper ores in a very few localities in the Southwest. In one locality, an aquifer tapped by domestic wells became contaminated by waste leach water discharged into the stream course that recharged the aquifer. In another area, water used in irrigation downslope from the mining area is becoming more mineralized. However, here drainage from abandoned underground workings may be contributing acid water.

101 Speaking broadly, leaching operations are few, some are so located that leakage, if taking place, does not affect existing water supplies. We may say that this problem has some potential but is generally more interesting than it is acute. A similar snap summary might be made relative to possible pollution from uranium mining and processing and from acid leakage at phosphate processing plants.

{102} In California and Alaska, large acreages of alluvial ground have been turned upside down in gold dredging. Here the surficial material has a very high degree of permeability. Following the line of argument outlined above pertaining to Illinois and Indiana, it would seem that in the gold fields a hydrologic benefit may have been gained. However, in a 1913 bulletin on the Fairbanks' gold fields, it was noted that the streams were flashy on dredged ground, but had lower peaks and higher low flows where they came off undisturbed ground. n5

102 n5 Prindle, L.M., and F.J. Katz. " A geological reconnaissance of the Fairbanks quadrangle, Alaska." U.S. Geological Survey Bulletin 525, 1913.

102 Mentally reexamining the California and Alaskan dredged areas, we can see that, although the ground there is undoubtedly highly receptive to recharge, it is also very highly permeable and drains rapidly. If ground becomes only moderately permeable, as in the Indiana and Illinois coal fields, we would look for a beneficial effect, but where the cast ground is very highly permeable, the hydrologic effects are undesirable in diminishing ground-water storage and imparting undesirable flow characteristics to streams and, without much doubt, a high sediment load.

102 PLANT COVER REDUCES SEDIMENTATION

102 Although not in the writer's field of specialization, a few more words may be said about sedimentation resulting from mine operations. Mining may be likened to urbanization in this respect. With great areas of ground broken up for dwellings and in the building of roads, ditches, and embankments, large areas of fragmented material are necessarily exposed to erosional forces and bleeding off of undesirable sediment into streams and reservoirs will almost inevitably occur. It is particularly interesting to note that measures to curb the sedimentation problem in urban areas involve, to a large measure, establishing a plant cover on the disturbed ground.

102 The mining industry is probably better prepared, by virtue of its research and thousands of acres of experimental plantings in a variety of climatic environments, to carry out sediment control measures than most municipalities. Further, the mining industry can eliminate some problems by planning and generally can exercise a unified control over large areas of affected ground, something which local governments cannot do in most urban areas.

SELECTED READINGS

ENVIRONMENTAL EFFECTS

DEPARTMENT OF THE INTERIOR

103 news release

103 Forrester (202) 343-4646

103 GEOLOGICAL SURVEY

103 For release April 9, 1971 EFFECTS OF STRIP MINING ON BASIN IN KENTUCKY
REPORTED

103 A report describing the influences of strip mining of coal on the hydrologic environment of a small stream basin in the Cumber land Mountains of Kentucky has been published by the U.S. Geological Survey, Department of the Interior.

103 The report, summarizing the findings of an 11-year (1955-66) interagency study of the 25-square-mile Beaver Creek basin in south-central Kentucky, reveals that strip mining of coal in the basin has significantly increased the acidity and mineralization of surface and ground water, and increased the sediment of streams below the mined area. These changes in water quality, in turn, have adversely affected aquatic life in the stream.

103 Strip mining in the Cane Branch basin, a small stream in the Beaver Creek watershed of McCreary County, Kentucky, afforded an opportunity to evaluate some of the effects of strip mining on the water, timber and land resources of the basin. Accordingly, a study by several Federal and State agencies was begun in the Cane Branch basin in 1955. Agencies collaborating on the report summarizing the studies are: the Geological Survey, Bureau of Sport Fisheries and Wildlife, the Forest and Soil Conservation Service, the Army Corps of Engineers, the University of Kentucky, and the Kentucky Department of Fish and Wildlife Resources.

103 C. R. Collier, R. J. Pickering, and J. J. Musser, hydrologists with the U.S. Geological Survey, and editors of the multi-author report, said that "Cane Branch became an acidic, highly mineralized stream in the spring of 1956 as a result of strip mining of coal in the southwestern part of the basin."

103 "Seepage and runoff from the spoil bank areas, and overflow from pools formed in the last mining cuts are the primary sources of the acid water that characterizes Cane Branch," the hydrologists said.

{104} After the second of the two periods of mining in the area ended in 1959, concentrations of dissolved constituents and acidity levels in Cane Branch began to decrease slightly from those recorded immediately after mining had begun. Little change in the chemical composition of the water in Cane Branch occurred during the last few years of the study. According to the report the water in Cane Branch is still acid and devoid of aquatic life.

104 Some of the findings of the investigators:

104 * The stream in the mined area carried 12 times the dissolved-solids load of a nearby stream unaffected by mining. During the period 1957-62, Cane Branch transported a net dissolved solids load of about 1,o70 tons per square mile of drainage area, as compared to 111 tons per square mile that was

transported by Helton Branch, a nearby stream that was unaffected by mining, and therefore used as a basis of comparison. The contribution of the spoil banks alone was 14,000 tons per square mile, a chemical contribution 126 times that of the unmined Helton Branch basin.

104 * Even after active mining ceased, the mined area yield 75 times as much sediment per square mile as the unmined area. Sediment concentrations in Cane Branch during the study period commonly exceeded 30,000 parts per million during storms, whereas the maximum concentration was only 553 parts per million for Helton Branch. The annual sediment yield from areas not affected by mining averaged about 25 tons per square mile compared to an average of more than 1,900 tons per square mile for Cane Branch during the four years following cessation of mining, 1959-62. The average annual sediment yield from the spoil banks was about 27,000 tons per square mile during this period, more than 1,000 times greater than the yield from undisturbed areas.

104 * Sediment concentrations decreased in 1960 after mining ceased, but remained much higher than in the unmined Helton Branch basin. Further decreases in sediment concentration probably will not occur until revegetation of the spoil banks is sufficient to protect the banks from erosion. Some of the transported sediment has accumulated in stream-bottom deposits in Cane Branch and in Highes Fork, its receiving stream.

104 * As acid water from the Cane Branch study area moves downstream, it is diluted and neutralized by inflow from streams containing bicarbonate alkalinity. The effects of the mine drainage are almost undetectable in Beaver Creek, 3 miles downstream from the mined area.

{105} * Acid water and smothering sediment have caused a decrease in the variety and abundance of bottom-dwelling organisms in Cane Brsnch and in Hughes Fork downstream from the entry of Cane Branch. Larvae of mayflies and caddis flies - the primary food for most small stream fish - were almost entirely absent from Cane Branch and were scarce in Hughes Fork as compared to streams unaffected by mining.

105 * No fish are present in Cane Branch, and only small seasonal populations are present in the most downstream part of Hughes Fork. The pH of Cane Branch water, commonly 3 to 4, is lethal to fish, and the limited fish

population in Hughes Fork may be due to the limited availability of bottom organisms that serve as food for the fish.

105 The report, which also describes effects of mining on tree growth and on microscopic organisms in the streams, is titled "Influences of Strip Mining on

the Hydrologic Environment of Parts of Beaver Creek Basin, Kentucky, 1955-66," and is published as Geological Survey Professional Paper 427-C. Copies may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 for $1.50 each (paper cover).

{106} [From the Christian Science Monitor, January 16, 1970]

106 MINING ORE WITH MINIMAL DAMAGE TO NATURAL BEAUTY

106 (By Robert Cahn)

106 EMPIRE, COLO. - Here in the mountains of Colorado, someone has changed the script.

106 Ordinarily, when an industry - in this case a major mining firm - plans a new development that may disrupt the environment permanantly, conservationists are up in arms, writing to congressmen, threatening law suits, fighting the "polluters" every step of the way.

106 But for once at least the would-be protagonists are sitting down over a conference table and trying to work out the problems before they happen.

106 The new Henderson molybdenum mine of the American Metal Climax Company (AMAX) is not due to go into opertion until 1974. Yet since 1966, a nine-member committee of company officials and representatives from the Colorado Open Space Council (COSC) have been holding frequent meetings.

106 Their purpose: to figure out ways in which the ore can be mined and a mill operated with minimal harm to the forests, streams, and wildlife and to the natural beauty of this Rocky Mountain area which straddles the Continental Divide, 40 miles west of Denver.

106 UNPLANNED MEETING

106 This "Experiment in Ecology," as it is called, is all the more unusual in that a "sister" mine of the company near Climax, Colo., is an acknowledged scar on the landscape. And conservation groups are protesting, and threatening a lawsuit, to stop a proposed molybdenum operation by another company in the Challis National Forest of central Idaho.

106 These days, starting any new mining development in wooded natural areas is to conservationists like waving a red flag in front of a bull.

106 The experiment came as the reslt of a mistake late in 1966 by two young lawyers, Stanley Dempsey and Roger Hansen, when both of them showed up for a conservation meeting at the right place on the wrong night.

106 Mr. Dempsey was then assistant counsel for the AMAX molybdenum division, and Mr. Hansen was executive director of COSC, the Rocky Mountain area's biggest conservation organization. Being a week early for the scheduled meeting, they decided at least to have dinner and discuss their mutual interest in conservation.

106 INITIAL HESITANCE

106 The talk quickly centered on the company's "Henderson" site near Empire, which Mr. Dempsey said might turn out to be one of the world's largest molybdenum deposits (molybdenum is an alloy used mostly for strengthening steel).

106 They agreed that a way should be found to avoid repeating the environmental damages of past operations in developing the Henderson site, and decided to see if the new mine could become an example of environmental planning. Shortly thereafter, four AMAX officials and five conservation leaders held their first meeting at the company office in Golden, Colo.

106 Both of the instigators of the experiment in ecology at first met doubt and resistance from within. Company officials felt that no matter how much they spent on environmental safeguards, they couldn't win - the conservationists would still be critical for the least changes that were made on the resources of nature.

106 The conservationists hesitated because they felt it might be just a publicrelations gimmick, and that the company would do as little as possible. Also, they were looked on with suspicion by other conservationists for consorting with the "enemy," and were accused of selling out their princples.

106 Mr. Hansen, who now is executive director of the Rocky Mountain Center on Environment, admits that if the proposed mine had been in a wilderness area, conservationists generally would have opposed it. But in this case the company had a right under existing mining laws to pursue the development and could not be legally stopped: The site was not in a protected wilderness area, nor was the land of unique and outstanding recreational or esthetic value.

106 FLORA AND FAUNA EXPLAINED

106 At the first committee meeting, Dr. Beatrice E. Willard of the Thorne Ecological Foundation showed color slides of the flora and fauna, and explained the interrelationships of resources in the fragile alpine ecology of the area.

107 The company executives, somewhat hesitantly at first, divulged in detail their plans for development of the mine and mill which would transform the buried ore into the powder-like molybdenum disulfide.

107 The major problem was: what to do with the finely ground rock tailings, the waste coming out of the mill which ordinarily is stored in ponds near the mine?More than 300 million tons of tailing are expected before the mine is exhausted.

107 The company planned, before the experiment in ecology started, to place the mill and the pond near the mine alongside a major highway through the scenic Rockies. But at the suggestion of the conservationists, a search was started for a new location.

107 EXPENSES REDUCED

107 After checking all possible locations within a 25-mile radius of the mine, company engineers discovered a site 13 miles away that was hidden from public view and where the mill could be built in a way that would create a minimum of pollution potential. But there was a catch. To reach this site the company would have to tunnel under the Continental Divide.

107 Company studies showed, however, that the $2 5 million cost for a nine-mile tunnel and a rail line above the Williams Fork Valley could be economically justified.

107 At first, the ideas for environmental improvement came from the conservationists. But now, says Mr. Dempsey, the spirit of conservation has caught hold with the engineers who seek new ways of doing things so that as much as possible of the natural setting can be preserved. And although many of the changes are costly and have to be absorbed in the interests of a better company image, some of the changes have resulted in reducing expenses.

107 On their part, the conservationists question everything, Mr. Hansen says.They even want an explanation for every tree the company wants to remove.

107 Some of the changes are small - but the cumulative effect is significant.

107 Instead of the ordinary galvanized steel buildings at the mine site, colored siding which blends with the setting is being used.

107 Culverts and trestles are planned so that the railroad will not cut off

the natural animal trails.

107 The topsoil and dirt removed from the main mine shaft is being kept in a pile, and the land will be reclaimed when the shaft is no longer needed.

107 Slopes that have been denuded around the mine for construction purposes are being reseeded. And operations have been kept as compact as possible so that only 300 acres are being used for the mine.

107 PUBLIC ACCESS PERMITTED

107 The mill will use water recycled from the tailing pond. And a series of canals will be built above the pond so water running off the mountain will bypass the pond. This should remove the danger that floods might carry tons of waste tailings into the valley below the ponds.

107 The company is permitting public access on thousands of acres of land around the mill site which had been closed to the public by the previous owners.

107 The conservation spirit was even infused into the utility which provides power to the mine site. The Public Service Company of Colorado was persuaded to cut selectively only a few trees where power lines were to go instead of bulldozing a a swath through the forests.

107 WIND PATTERNS CONSIDERED

107 A team of horses was then used to bring out the cut trees. The transmission towers were brought in by helicopter. And instead of using shining aluminum towers, the utility supplied wooden ones painted a shade of green designed to weather and blend into the setting.

107 Not all of the ecological problems have yet been solved. Dr. Willard, for instance, feels that information about wind patterns in the area of the tailing pond is inadequate, and that studies should be made to find out in the molybdenum tailings might be swept into the air in strong winds and carried into areas where they could affect plant life.

107 "We feel the experiment has been a success so far," says Mr. Dempsey. "However, we have a lot to learn about how we are going to do reclamation work on the tailing ponds. And we are planning to hire a full-time ecologist next month.

107 "The experiment has proved that an industry can work with conservationists in developing an operation. We hope it will serve as an

example to others in industry and in conservation."

{108} Mr. Hansen agrees that the experiment has proved that conservationists can cooperate with industry in some cases. But he points out that some types of development in some locations are not consistent at all with protection of environmental values.

108 In these cases, where environmental damage would far outweight the gains, conservation groups may legitimately oppose any kind of development, or seek to have the development moved to an area where it will not cause damage.

108 [From the Denver Post, Aug. 18, 1971]

108 NEW HENDERSON MINE: MINING, ENVIRONMENT MOUNTAIN

108 (By Dick Prouty)

108 EMPIRE. - Can a herculean mining operation costing $2 50 million and taking eight years just to begin production be compatible with the Rocky Mountain environment?

108 For the Henderson Project of Climax Molybdenum Company the answer seems to be "yes."

108 The Henderson Project is a plan to mine molybdenum ore under 12,315 foot Red Mountain 8 miles west of here, about 50 miles west of Denver.

108 The ore body, with about 4 1/2 to 5 pounds of molybdenum being extracted per ton of ore, is large enough to last 30 or more years, Climax officials say.

108 FIFTY MILLION POUNDS

108 Annual production is to be 50 million pounds of molybdenum.

108 The second of three Henderson shafts now is being put down 3,100 feet into the same mountain from which Climax' Urad Mine is extracting ore. Later a third shaft will be sunk.

108 To get the ore to the mill, 14.6 miles away, a 10-mile-long tunnel is being bored between the mine, under the Continental Divide to the upper reaches of the Williams Fork River.

108 Harold Wright, Henderson mine manager, said that when full production gets under way - target date is 1975 - six completely automated electric trains

with 30 cars each will be shuttling back and forth between mine and mill.

108 "They're completely automated, there's no one in them at all," Wright said of the trains, which are a low-profile narrow-gauge type.

108 Each train will have four, 50-ton rated locomotives of the Swedish ASEA manufacture, he said.

108 At the mill, where a mountain is being leveled for the site of a crusher and mill, two tailings ponds and a water reservoir also are under construction.

108 According to Bill Reno, Climax construction engineer, the tailings ponds will require about 130 acres of the 18,000 acres of land Climax has bought in the Williams Fork drainage.

108 The project isn't just Climax. It's also the product of the Thorne Ecological Foundation, Boulder, the Denver-based Rocky Mountain Center on Environment (ROMCOE), the U.S. Forest Service, Colorado Water Pollution Control Commission, the Colorado Open Space Council and others.

108 PAYING THE BILL

108 But it is Climax, a subsidiary of American Metals Climax, New York City, that's paying the bill. The environmental safeguards were undertaken with "a great deal of apprehension on both sides on how it would work out," said Jim Gilliland, a Colorado native who is director of environmental controls for Climax.

108 How much the environmental considerations will cost hasn't been calculated. But it's plenty, a company official said.

108 The first environmental controls were extensions of conservation measures worked out between the U.S. Forest Service and Climax in the early 1960s when the Urad mine was reopened.

108 The Colorado Water Pollution Control Commission didn't even exist then, but the Climax representative, the late Ernie Jones, pioneered the ecological outlook with Neil Edstrom, former Idaho Springs forest ranger.

{109} LODE DISCOVERED

109 The Henderson lode was discovered in the mid 1960s. The scope of mining more than 300 million tons of ore, of having water for milling, tailing ponds for nearly 1,900 pounds of mill waste per ton, power lines, roads, housing for workers and other impacts on the environment generated studies on the ecological significance of the development.

109 Stan Dempsey, Climax attorney, was active in conservation work and as plans for Henderson were outlined he sought a broader input on environmental aspects from the fledgling Colorado Open Space Council.

109 Climax officials including Dempsey, Don Stephens and Bill Distler, then Henderson Project director and now in charge of mining operations for it, Urad and the Climax, Colo., mines, met with Roger Hansen, now executive director of ROMCOE; Bob Weiner, of COSC; Dr. Beatrice Willard, of the Thorne Ecological Foundation, and with others worked out what is known as "An Experiment in Ecology."

109 FROM BEGINNING

109 "The important thing," Distler said, "is that environmental considerations were a part of Henderson from the beginning."

109 The cooperative attitude of conservationists surprised some company officials and vice versa. But there were environmentalists who weren't - and aren't - happy about another development invading the mountains.

109 "It can't be hidden," Hansen acknowledged, "the landscape is considerably disturbed. But the impact is definitely minimized. There's no question about it."

109 "With all the construction, you can't tell now what it's ultimately going to look like," Hansen said.

109 "But the way it's going, the way it has gone and is intended to go, Henderson will be an ecological model for industrial development. I don't know of anyone in the country who has done the things Climax has done," he said.

109 WORK WITH PEOPLE

109 "We've been accused of doing a 'sell-out,' of being a turncoat to the environment and all sorts of things," Hansen, a lawyer and planner, said, "but environmentalists have to accept responsibility and to work with people in good faith."

109 The results of that faith are just beginning to show. For example:

109 - Ute Creek, the Williams Fork River, West Fork of Clear Creek and other streams are flowing clear and sparkling despite the enormity of the earthmoving

and other work being done near them.

109 - Clumps of trees at the mine, near the railroad and powerline rights of way were left standing instead of being cut down. In one case a spruce fir stand with trees more than 300 years old still stands - a powerline route was changed instead of cutting the trees.

109 ABOUT 850 TREES MOVED

109 More than $2 0,000 was spent to dig up 850 trees - aspen, fir, spruce, pine - from 4 to 40 feet high and transplant them to provide a 100-yard-long test screen to a high tailing pond. The test plot, that is watered almost daily, will show what kind of trees can best survive the transplant shock. Eventually more trees will be moved to form a screen more than a third of a mile long.

109 While more than 300 acres of timber were harvested much of the waste was chipped for mulch instead of being burned.

109 Topsoil is stockpiled until final earth moving and construction is complete and then it will be distributed, seeded and planted with grasses, shrubs and trees.

109 The 10,000 gallons of water needed each minute in the milling process is to be recycled, a process that saves water and avoids pollution.

109 WATER COOLED

109 The 5,000 gallons a minute of warm water encountered in sinking shafts to the working mine level is being aerated to cool and oxygenate it before it goes into clear Creek via settling ponds.

109 New concepts in power line rights of way and screening were pioneered by Climax and Public Service Company of Colorado. No more wide, straight swathes through the mountains. The wires and towers are treated to blend instead of contrast with their surroundings.

{110} Acres of grass now green disturbed slopes that would have been ignored before. A tertiary sewage treatment plant, almost a high-altitude experiment plant, at 10,320 feet, is planned for the mine and offices.

110 In the next century, when mining is over, plans for using the reservoirs and tailings ponds already have been outlined.

110 Fundamental to all this are the ecological inventories made and continuing under the direction of Dr. John Marr, noted University of Colorado ecologist, and Dr. Richard Beidleman, of Colorado College, and others involved in the Colorado environmental movement.

110 "This way we know what the situation was, what it is, and if it changes how it's changed so we know what to do about it," Gilliland said.

110 "We'll have the actual data. Instead of guessing and theorizing, we'll know," he said. He was referring to plant, wildlife, water life and other continuing studies.

110 One of the really tough problems is tailings reclamation. Work at the old Climax, Colo., mine has proven the challenge. Dr. William Berg of Colorado State University, is seeking reclamation answers under a Climax grant.

110 PROVIDE ACCESS

110 Not all the environmental improvements have worked. One that failed was Climax plans to open up thousands of acres of its own land in the Williams Fork Valley, and provide access to the Arapaho National Forest, for hunters and campers.

110 But the guests drove their vehicles across meadows, mountainsides and in other ways tore up the land.The area is now barred to vehicular access, Don Stephens, Climax, public relations representative, said.

110 "It's still open," he said, "you just have to walk or ride a horse."

110 He said Climax is considering running a twice-a-day truck route in the area this fall. Then hunters can haul their deer or elk to the access roads, and it will be brought out in the company truck to the county road.

110 The impact of the enormous project and anticipated satellite development on the Williams Fork is a major concern of Colorado Game, Fish and Parks officials.

110 "It's going to change deer and elk migration routes, population concentrations and other factors," Paul Gilbert, area supervisor at Hot Sulphur Springs, said. To the west, across the Williams Fork Mountains, development in the Blue River Valley is affecting dder, elk, upland game birds as well as stream life.

110 He estimated there are 500 elk and about 500 deer in the area now.

110 WATER COMPETITION

110 Competition for water by various interests, including Climax, Denver and other developers is also worrying trout enthusiasts, he said.

110 "They're making every effort they can to keep the stream clean, but it's the combination of effects including adequate stream flows that concern me," Gilbert said.

110 The opening of once closed ranches and foot access to the national forest is working out "surprisingly well," he said.

110 Distler said the company spent weeks searching for a mill and tailing site that would minimize the environmental impact. Of 36 sites, only two were environmentally satisfactory.

110 The result is a small scenic valley just west of the Williams Fork River, north of Ute Pass.

110 A portion of the two-track, narrow-gauge railroad between the tunnel portal and the mill will be visible from the county road that follows the river back up the valley from the Colorado River.

110 The tunnel will be more than 52,000 feet long. The Dravo Corporation has bored more than 3,000 feet underground from the Williams Fork side.

110 The tunnel and train are expected to cost $5 0 million.

110 [From the Washington Star, Aug. 15, 1971]

110 THREAT AT FROSTBURG STATE - STRIP MINING TO INVADE CAMPUS?

110 (By Lee Flor)

110 FROSTBURG, Md. - Frostburg State College suddenly has found itself confronted with a most unusual problem - the possibility that a strip mining operation may someday gobble up the southern half of its campus.

{111} The college has had high hopes for the southern half of the 212-acre campus. In its 10-year master plan, the administrators planned to put in two buildings and to build a winding road back in the rolling foothills of the land, which is at the base of the Big Savage Mountain.

111 Other parts of the southern 100 acres were to be an "ecology center," and would be natural woodland, reserved for whatever future use was needed.

111 But for years, the college administrators did not know that the mineral rights to the land were not owned by the college. Instead, they belong to the Georges Creek Big Vein Coal Company.

111 VIEWED FROM ABOVE

111 Strip mining already is being carried out higher on the slopes of the Big Savage. And from those high slopes, strip miners are viewing the campus and down below.

111 Ironically, the very battle the ecologists have been waging to halt air pollution, in turn, has caused the seam of coal under the campus to have more value.

111 Before, it was not economical to strip off the top 30 to 40 feet of surface soil to dig out a 36-inch thick seam of coal. But the seam of coal is no ordinary coal. It is Tysons Coal, and has a very low percentage of sulphur.

111 Ecologists have complained that high-sulphur coal creates too much sulphur dioxide when burned, so recent state and federal regulations have limited many power plants to burning only coal with 1 percent or less sulphur.

111 A few miles from Frostburg, the Virginia Electric Power Co. (Vepco), which supplies almost all of the electric power in Northern Virginia, has a major power plant. The plant, at Mt. Storm, W. Va., has to buy much of its low sulphur coal from the strip mining operation on Big Savage Mountain above Frostburg College.

111 So the fight to halt air pollution has transferred the problem to the Big Savage Mountain slope, and indirectly, is posing a threat to the small Frostburg campus.

111 MINERAL RIGHTS

111 Richard B. West, the Frostburg college administrator who has been dealing with the problem of the mineral rights and the strip mining possibility, said that no one was sure why the state had not acquired the mineral rights when it bought the land for the campus.

111 "It's common up here in the mountains for mineral rights to be owned separately from surface rights," he said.

111 The southern half of the campus was bought when the Maryland State Roads

Commission had to acquire some right-of-way for its National Freeways now under construction south of Frostburg. The commission had to acquire a large parcel of land in negotiating with one landowner, and some 100 acres of the land turned out to be surplus after the freeway blueprints were finished. The land

adjoined the small campus occupied by the old Frostburg College, so the state gave it to the campus.

111 West said the question of the mineral rights never came up until several years ago when the college, in the great tradition of college grantsmanship, asked for and received a grant from the Appalachian Regional Commission.

111 The $6 6,000 grant was for a pioneering effort to reclaim an old strip mine excavation in the 100-acre area. As part of the preliminary work under the grant, title examiners discovered that the mineral rights were owned by the Georges Creek Co.

111 600 TONS

111 The land just above the campus is now being strip mined by the Winner Brothers Coal Co., which owns some land and leases other land for its operations. Every day, the Winner Brothers, George and Albert, mine an average of some 600 tons of coal from their strip mining operation, with much of this destined for the Vepco power plant.

111 In the negotiations between the Georges Creek Co. and the college, the Winners have become an issue. Because they already are operating a strip mine bordering the campus, Robert C. Harvey, manager of the Georges Creek Co., has proposed leasing the campus coal rights to them.

111 Under his proposal, the Winners would strip off the top 30 to 40 feet of surface material, and then would scoop out the seam of low-sulphur coal. They would then backfill the strip mine area, and would plant trees and grass on the surface.

{112} RESTORATION PLANNED

112 As part of their project, they would restore the old excavations left by previous strip mining there some 20 years ago, and then, finally, Georges Creek would surrender all mineral rights to the land.

112 However, West said the college felt it would be barbaric to have a strip mine on campus. He said he was working with Allan S. Levy, assistant Maryland attorney general, to work out some compromise which would avoid strip mining on

the campus.

112 He said that at one point, Georges Creek had offered to sell the campus mineral rights to the state for $8 0,000. Levy and West and Georges Creek are still negotiating, and Levy said he felt there was a good chance they could work out a settlement, because Georges Creek management was trying to cooperate.

112 "If nothing else works, we can condemn the mineral rights," Levy said.

112 Other state agencies have higher powers of condemnation, called the "quick take," which permits a road agency, for example, to seize a right-of-way and argue in court afterwards about its value.

112 The state apparently does not have this much power for a college. But then, whoever expected a college to face the peril of a strip mine.

SELECTED READINGS

ECONOMICS

STRIP MINE RECLAMATION AND ECONOMIC ANALYSIS

116 DAVID B. BROOKS *

116 * Economist, Resources for the Future, Inc., Washington, D.C. I acknowledge with thanks the assistance of Robert K. Davis, Jack L. Knetsch, Allen V. Kneese and Edwin H. Montgomery, all of whom contributed to the paper through numerous discussions as well as by their comments on an earlier draft.

116 It was proved conclusively that the stripping had no near or substantial relationship to the public health, safety, [*] welfare.

116 - Edwin R. Phelps n1

116 n1. E. R. Phelps, Current Practices of Strip Mining Coal, in Proceedings of Symposium on Surface Mining Practices 8 (Univ. of Ariz. College of Mines 1960).

116 With strip mining and its companion, the auger-mining process, the shades of darkness moved close indeed to the Cumberlands.

116 - Harry M. Caudill n2

116 n2.H. M. Caudill, Night Comes to the Cumberlands 305 (Atlantic-Little, Brown 1963).

116 It has almost become a cliche to describe strip mining for coal as "rape of the land." Strip mining is a surface method in which large power shovels - some of them the largest in the world - "strip" off the soil and rock overlying coal beds, dump it to one side, and then load the underlying coal onto trucks. n3 An extremely productive method of mining, n4 it nevertheless evokes strong reactions because the unwanted soil and rock are turned into long, successive ridges of unsorted, ugly, and unproductive waste as "strip" after parallel "strip" of earth is mined.These man-made badlands extend over large areas, each ending in a deep pit, the last strip mined out, beside which is a cliff called the highwall. With "area stripping," used in relatively flat terrain, the entire surface area is turned into giant washboards. With "contour stripping," used in mountainous areas, the strips resemble looped shoestrings as they

follow the sinuous outcrop of a coal seam, leaving a gash of one hundred feet or so in the hillside. Finally, with "auger mining," a relatively new technique, drills as large as seven feet in diameter bore into a seam (often into a high-wall left by stripping) from the surface, leaving it perforated by a series of holes from which the coal has been removed. n5 Any of these methods may cause extensive pollution and erosion damage downslope and downstream of the mine site unless the mine is carefully managed. n6

116 n3. The word "strip" is used both as a verb indicating the removal of overburden and as a noun describing the long, thin plan of the areas mined out in each stage of advance. Many discussions of strip mining are available: O.E. Kiessling, F.G. Tryon & L. Mann, The Economics of Strip-Coal Mining (Economic Paper No. 11, U.S. Bureau of Mines 1931); H.D. Graham, The Economics of Strip Coal Mining (Bull. No. 66, Bureau of Economic and Business Research, Univ. of Ill. 1948); University of Ariz. College of Mines, Proceedings of Symposium on Surface Mining Practices (1960), especially E.R. Phelps, Current Practices of Strip Mining Coal, id. at 1.

116 n4. In 1962 the average productivity at bituminous coal and lignite strip mines in the United States was nearly 27 tons per man per day. The average at underground mines was 12 tons. The absolute difference between the two rates has been increasing 2 U.S. Bureau of Mines, Minerals Yearbook, Fuels 71, 86 (1962) [hereinafter cited as Minerals Yearbook, Fuels].

116 n5. Minerals Yearbook, Fuels 98-101. See also W. A. Haley & J. J. Dowd, The Use of Augers in Surface Mining of Bituminous Coal, in Report of Investigations 5325 (U.S. Bureau of Mines 1957). The average productivity at auger mines in 1962 was about 35 tons per man per day; cf. note 4 supra.

116 n6. Among the many descriptions of the effects of strip mining on landforms, watercourses, and land use, the following, which do not agree in all

respects, were found particularly useful: G. S. Bergoffen, A Digest: Strip-Mine Reclamation (U.S. Forest Service 1962); C. R. Collier et al., Influences of Strip Mining on the Hydrologic Environment of Parts of Beaver Creek Basin, Kentucky, 1955-1959 (Professional Paper No. 427-B, U.S. Geological Survey 1964); G. F. Deasy & P. R. Griess, Coal Strip Pits in the Northern Appalachian Landscape, J. Geography, Feb. 1959, p. 72; A. Doerr & L. Guernsey, Man as a Gromorphological Agent: The Example of Coal Mining, Annals of the A. of American Geographers, June 1956, p. 197; L. Guernsey, Strip Coal Mining: A Problem in Conservation, J. Geography, April 1955, p. 174; G. A. Limstrom, Forestation of Strip-Mined Land in the Central States (Agricultural Handbook No. 166, Central States Forest Experiment Station 1960); Tenn. Dep't of Conservation and Commerce, Conditions Resulting From Strip Mining for Coal in Tennessee (1960); TVA, An Appraisal of Coal Strip Mining (1963).

{117} Strip mining for coal in the United States will be one hundred years old in 1966, but during much of this time it was not an important method. Since the 1930's, however, strip mining has grown to account for one-half of all anthracite and nearly one-third of all bituminous coal and lignite mined in this country. n7 It has recently been estimated that operating and abandoned strip pits now occupy 500,000 acres in the Appalachian and Midwest coal fields. n8 Since the 1930's, coal strip mining has been attacked - and defended - in literally hundreds of emotional articles, speeches, and political campaigns. During the same period scientific knowledge about the effects of strip mining has been developed from a variety of sources. Both science and emotion are

represented in current opinion and in the body of legislation that regulates strip mining in the important producing states. n9

117 n7. Minerals Yearbook, Fuels 84-86, 172. A brief history of surface mining is presented by J. W. Feiss, Surface Mining - Minerals, Men, and Divots, Paper Delivered to the Conference on Surface Mining conducted by the Council of State Governments, Roanoke, Va., April 13, 1964, p. 6 (mimco.).

117 n8. TVA, op.cit. supra note 6, at 4. An estimate made five years ago concluded that, "on the average, some two acres of every square mile in the Northern Appalachian Coal Fields, and a slightly smaller acreage of every square mile in the Eastern Interior Coal Fields, consist of strip pits." Local concentrations are, of course, much higher. Deasy & Griess, supra note 6.

117 n9. In 1962 bituminous coal and lignite stripping was practiced in 22 states.However, six states - Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia - accounted for about 85% of the tonnage produced. These states and Maryland have laws regulating strip mining. R. G. Meiners, Strip Mining Legislation, 3 Natural Resources J. 442, 443 (1964).

{118} As yet, however, little effort has been devoted to subjecting these questions to economic analysis. n10 The purpose of this article is to indicate what economics has to say about coal strip mining and attendant efforts to protect other natural resources. More explicitly, I will argue that the private profit signals to which coal stripping firms must and should respond to maximize their profits are not adequate guides for maximizing social welfare. In many situations private market decisions can be relied upon to yield an approach to maximizing social welfare, but this is not the case whenever there is a divergence between private costs and social costs, like the situation presented here. The essence of the strip mining problem is that substantial costs resulting from the process of stripping are imposed on other individuals and are not reflected in the accounts of the coal mining firms.

118 n10. Bergoffen, op.cit. supra note 6, at iii.

118 It will be convenient to use the term "reclamation" to mean efforts devoted to controlling the use of land while it is being stripped as well as efforts devoted to bringing back to use land that was stripped in the past. The term "regulation" will refer to a legal enactment to accomplish one or both of these goals. In popular statements both reclamation and regulation are commonly called "conservation."

118 THE UNIQUENESS OF COAL STRIP MINING

118 Why has coal strip mining attracted more attention than other mineral commodities mined in open pits? The answer lies in a combination of reasons. First, coal strip pits are common in the wooded and agricultural areas of the populous eastern half of the country, not in the remote and semi-arid West. Second, compared with other non-metallic minerals mined in large quantities in the East, coal stripping requires the production of much larger amounts of waste. n11 Third, compared with open pit metal mines, coal strip pits are very short-lived. The coal is mined from an area within a year or a few years, while iron or copper pits often remain in existence for half a century or more. Fourth, coal mines (not only strip mines) present certain problems not common to other mines. Coal, both in place and in dumps, is inflammable. Some 220

fires are burning in underground seams today and about 500 more burn in waste piles. n12 Many coal seams also carry iron sulfide minerals that react with air and water to form sulfuric acid, thus producing the widespread acid mine drainage that is toxic to fish and vegetation and which causes extensive corrosion damage. n13

{119} n11.Typically the ratio of waste to coal is 12:1.The ratio of waste to usable product is much higher in low-grade metal mines, but the great bulk of the waste is not produced at the mine but at mills and smelters where it can more easily be handled. Feiss presents an outline comparing the physiographic effects of different mining methods; op.cit. supra note 7, at Fig. 1.

119 n12. U.S. Dep't of the Interior, Annual Report of the Secretary for the Fiscal Year 397 (1962); R.W. Stahl, Survey of Burning Coal-Mine Refuse Banks 1 (Information Circ. No. 8209, U.S. Bureau of Mines 1964).

119 n13. The following are useful introductions to the acid mine drainage problem: G.P. Hanna et al., Acid Mine Drainage Research Potentialitics, 35 J. Water Pollution Control Federation 275 (1963); G.D. Beal, Common Fallacies About Acid Mine Water (Sanitary Water Bd., Pa. Dep't of Health 1953) (mimeo.); and any of the papers by S.A. Braley appearing in mining journals during the 1950's.

119 Finally, there are factors that are less definable. Coal mining is a symbol of the industrial revolution and carries with it a congeries of impressions for some people: impersonality, monopoly capitalism, absentee ownership, etc. To these, stripping adds the following: wholesale and rapid change in land use; serious deterioration in a familiar landscape; and extensive stream and valley pollution. It has also been suggested that stripping offends most seriously not by creating ugliness per se, but by creating ugliness in areas where one least expects to find it.

119 Given this complex of issues - partly rational, partly mystical, but always strongly felt - it is more apparent why individuals with otherwise diverse interests - sportsmen, farmers, conservationists, and even underground miners - could unite in their opposition to strip mining. n14 During the past several decades, therefore, strip mining has been generally and popularly regarded as an evil, mitigated only in part in its high productivity. But this was not the only dilemma that it posed. Conservationists looked with disgust upon the resulting landscape, yet they had to admit that strip mining recovered a greater proportion of the coal than did underground mining. n15 Agronomists emphasized the loss of arable land to strip pits, yet they had to admit that poor farming practices resulted in a far greater loss. n16 Social scientists worried about effects of stripping on local communities, yet they had to admit that stripping not only provided much needed employment in coal towns but also had a far better safety record than underground mining. n17

{119} n14. Indications of both open and hidden attacks by underground miners on the lower cost strippers can be found scattered through the mining literature. Rather more surprising is the fact that the TVA, once the delight of conservations, is being cast by them in the villain's role for allegedly ignoring the effects of strip mining to purchase cheap coal for low-cost thermal power.

119 n15. Strip mines recover 90% or more of the coal in place whereas underground mines seldom recover more than 50%. This conflict is typified in

an article by W. C. Bramble, Strip Mining: Waste or Conservation ?, American Forest, June 1949, pp. 24-25.

119 n16. See, e.g., H.R. Moore & R.C. Headington, Agricultural Land Use as Affected by Strip Mining of Coal in Eastern Ohio 34 (Bull. No. 135, Ohio State Univ. Agricultural Experiment Station 1940) (mimeo.).

119 n17. In 1959 the accident frequency rates at underground bituminous mines were 1.02 fatal and 42.71 nonfatal accidents per million man-hours. The rates at strip mines were respectively 0.46 and 20.69. At auger mines the rates were 0 and 21.20. D. Drury, The Accident Records in Coal Mines of the United States 96-97 (Dep't of Economics, Univ. of Ind. 1964).

119 Thus, to most people any judgment of the social value of coal strip mining has always been a matter of balance. And it is just this kind of balancing, of choosing among alternatives when there are real and difficult conflicts, that economic analysis is designed to handle. n18 Economic analysis does this by providing a rational and operational set of rules for determining whether the benefits from any action outweigh the costs. Moreover, in situations like strip mining, where private costs are not equal to social costs, all costs can, at least in principle, be incorporated so that the general goal of public policy, to maximize net social benefits, can be pursued.

119 n18. P. A. Samuelson, Economics: An Introdustory Analysis 1-7 (5th ed., McGraw-Hil 1961); R. A. Dahl & C. E. Lindbloom, Politics, Economics and Welfare 18-28 passim (Harper & Bros. 1953).

119 The remainder of this paper is divided into three sections. The first is a review of how approaches to strip mine reclamation have changed during the past several decades.The second is a series of conclusions pertinent to economic analysis that I have drawn from the literature, from interviews, and from field observations. Then, in the third section tentative suggestions are made about the application of economic concepts to policy problems.

119 A final note before proceeding. The emphasis in this paper is on the effects of strip mining on natural resources. There is reason to think that the more immediate problems may relate to the people who live in and move out of strip mined areas. Indeed, a large proportion of strip coal comes from the poverty-stricken region defined as Appalachia. n19 Human resources and natural resources are related, of course, and I could not disagree if it were stated that the first emphasis in these areas should be placed on education rather than

on reclamation. n20

{121} n19. President's Appalachian Regional Comm'n, Appalachia 42-44 (1964).

121 n20. This is surely a major theme of Harry Caudill's book, Night Comes to the Cumberlands (Atlantic-Little Brown 1963), especially pp. 305-24. It is also the principal conclusion in M. J. Bowman & W. W. Haynes, Resources and People in East Kentucky 244-46 (Johns Hopkins Press for Resources for the Future, Inc. 1963). These two books should be acknowledged as the source of my interest in these problems. II

121 CHANGING APPROACHES TO THE PROBLEM

121 Beyond noting the few articles in economics journals, the purpose of this section is not to review the extensive literature on strip-mine reclamation and regulation. n21 Rather, it is to point out the decided change in both tone and content discernible in serious considerations of the subject.

121 n21. The pamphlets by Limstrom and Bergoffen, note 6 supra, include reviews of the literature. Three bibliographies have been prepared: G. A. Limstrom, A Bilbliography of Strip-Mine Reclamation (Misc. Release No. 8, Central States Forest Experiment Station 1953); K. L. Bowden, A Bibliography of Strip-Mine Reclamation 1953-1960 (Dep't of Conservation, Univ. of Mich. 1961) (mimeo.); D. T. Funk, A Revised Bibliography of Strip-Mine Reclamation (Misc. Release No. 35, Central States Forest Experiment Station 1962).

121 A. Agriculture and Agricultural Journals

121 Scattered articles on the effects of strip mining and on the minor reclamation efforts of the time began to appear in the 1920's. n22 Discussion warmed considerably in the following decade but focused less on the ill-effects themselves than on the amount of land that was taken, probably permanently, out of agricultural production. The arguments were not well supported and tended to reflect agrarian values.

121 n22. These early activities were usually reported in the Journal of Forestry.

121 During the late 1930's, two forces initiated a change in the tenor of discussion. The first was the research interest that state agricultural experiment stations and the Central States Forest Experiment Station of the United States Forest Service began to show in strip mine reclamation. (In the case of acid mine drainage, state engineering experiment stations and the United

States Public Health Service served in a similar relationship.) The experiment stations viewed problems created by mining like they did those problems created by farming: they saw damages; they analyzed their nature; and they sought ways of coping with them. n23 Moreover, they financed or inspired studies by individuals in related fields - ecologists, fish and wildlife biologists, hydrologists - so that many disciplines have contributed to our present knowledge of strip pits.

{122} n23. Much of this work was published in the Proceedings of the state academies of science rather than in an official publication.

122 Strip mine legislation was the second force. West Virginia passed the first regulatory law in 1939, n24 and other states followed suit. As state agencies were established to administer the law and carry out reclamation activities, a demand was created not only for researchers but for foresters and agronomists who could put findings into practice over large areas. But perhaps the main contribution of the state laws was a shift of emphasis from cure to prevention, from post-mining reclamation to regulation designed to avoid damages. Moreover, as the postwar agricultural revolution muted the argument that stripped land was needed for food production, the publicoriented perspective of state agencies encouraged them to further shift their emphasis toward recreational use of stripped land.

122 n24. W.Va. Acts 1939, ch. 84.

122 B. Mining Industry and Journals

122 For the most part during the prewar years the strip mining industry denied legal or moral responsibility for the effects of stripping. However, as the first results of reclamation research became available, a few companies did experiment with reforestation. Also, several statewide associations of strip mining firms - usually the larger ones - were formed to carry out reclamation programs. n25 Gradually the prevailing attitude shifted from do-nothing to one that could be called "industry oblige ." But so long as voluntary reclamation was held to be the appropriate policy, strippers fought every state law. n26 Organized efforts were devoted to opposing bills introduced in state legislatures and, when passed, fighting them in the courts. Nevertheless, some laws were passed and, with the exception of a poorly drafted Illinois statute, upheld by the courts as a legitimate use of the police power to protect the general welfare. n27

{123} n25. A. L. Toenges, Reclamation of Stripped Coal Land, in Report of Investigations 3440 (U.S. Bureau of Mines 1939); L. E. Sawyer, Reclamation and Conservation of Stripped-Over Lands: Indiana, Mining Congress J., July 1946, pp.

26-28.

123 n26. For a recent statement that reflects the earlier opposition to any compulsory reclamation, see W. H. Schoewe, Land Reclamation, Mining Congress J., Sept. 1960, pp. 92-97, and Oct. 1960, pp. 69-73.

123 n27. Meiners, supra note 9, at 445. G. D. Sullivan, Presentation Before the Mineral and Natural Resources Law Section, American Bar Association, Chicago, Aug. 12, 1963 (mimeo.).

123 Today state regulation is no longer opposed by the strip mining industry as a whole. Indeed, one often hears a call for stricter enforcement. n28 There remains some opposition to extending legislation to states which do not now regulate strip mining, n29 but the more broadly supported industry position is to oppose: (1) federal investigation of any kind, n30 and (2) state laws placing responsibility on the industry for lands stripped and abandoned before existing legislation went into effect. n31

123 n28. A. E. Lamm, Surface Mine Reclamation - Why and How, Mining Congress J., March 1964, p. 25; D. Jackson, Strip Mining, Reclamation, and the Public, Coal Age, May 1963, p. 94. Interstate groups like ORSANCO are also favored over federal regulation; see W. A. Raleigh, A Acid-Drainage Curbs Are Here, Coal Age, April 1960, pp. 80-84. There are two "ulterior purposes" that are at times alleged to be of influence in the call for stricter enforcement: (1) an attempt to take the steam out of efforts to strengthen existing laws, and (2) an attempt to force the smaller stripping concerns out of business.

123 n29. Schoewe, supra note 26.

123 n30. Lamm, supra note 28; Meiners, supra note 9, at 460. This position is somewhat inconsistent with complaints that reclamation requirements in one state are more expensive than those in another.

123 n31. West Virginia is alone in having a fund into which strip miners pay a fee for reclamation of land mined in the past. Meiners, supra note 9, at 458.The ORSANCO rules for control of acid drainage define no responsibility

for abandoned mines.

123 Articles on strip mine reclamation have appeared regularly in the mining press since about 1946. n32 Most articles have been written by officials of the now very active reclamation associations set up by the strippers. These organizations, staffed by foresters and agronomists, were better equipped to utilize the techniques developed by the experiment stations than were mining

companies. Their professional attitude is probably the source of the most recent shift in the industry attitude. The goal of "industry oblige" was to reduce opposition to stripping, much as institutional advertising might improve the public image. But agronomists and foresters, like miners, are interested in production; they shifted the emphasis from public relations to gaining income from mined-out land through commercial forestry, grazing, or (increasingly) charging user fees for recreational use. n33

123 n32. Most of these articles appear in Coal Age or Mining Congress Journal.

123 n33. L. Cook, A New Approach to Strip Land Reclamation, Mining Congress J., Aug. 1963, p. 68, and Reclaiming Land for Profit, Coal Age, Oct. 1963, p. 94; Jackson, supra note 28. In 1963 a national organization, the Mined-Land Conservation Conference, was fomred in Washington, D.C., to coordinate and publicize the work of state association. The "Voluntary Industry Program for Surface Mined-Land Conservation" of the Conference would be ideal if it were actually practiced. See Mined-Land Conservation Conference, Surface Mine Land Conservation 1-4 (undated) (mimeo.).

{124} C. Economics Journals

124 It is surprising that during three decades of widespread interest only four articles on strip mining have appeared in economics journals. n34 Of these, only one considers strip mining in a framework explicitly separating private and social values. n35 Another essentially proposes application of a social rate of discount to strippable farm land to retain it in agriculture. n36 A third presents a useful critique of strip mine legislation. n37 And the fourth, written by a geographer, describes the effects of strip mining in a semi-arid region. n38 As a matter of fact, the work of several geographers deserves substantial credit for today's more rational climate of opinion and comes close to providing, albeit qualitatively, the kind of analysis urged in this paper. n39

124 n34. In addition, strip mining in the context of establishing "safe minimum standards" for conservation practice has been discussed by S.V. Ciriacy-Wantrup, Resource Conservation: Economics and Policies 264-65 (Univ. of Cal. 1952).

124 n35. H. W. Hannah & B. Vandervliet, Effects of Strip Mining on Agricultural Areas in Illinois and Suggested Remedial Measures, 15 J. Land & P.U. Econ. 296 (1939).

124 n36.C. L. Stewart, Strategy in Protecting the Public's Interest in Land with Special Reference to Strip Mining, id. at 312.

124 n37. Meiners, supra note 9.

124 n38. A. H. Doerr, Coal Mining and Changing Land Patterns in Oklahoma, 38 Land Econ. 51 (1962).

124 n39. See especially G. F. Deasy & P. R. Griess, Coal Strip Mine Reclamation, Mineral Industries, Oct. 1963, p. 1; Guernsey, Strip Coal Mining: A Problem in Conservation, supra note 6.

124 The comments above should not be taken to imply that economic considerations are absent in other studies, for information on reclamation cost is given in many articles. However, the data presented are typically very general or very specific. More important, cost is reported as if reclamation were a production process in which private costs could be simply tabulated against private returns.In short, economic data have sometimes been reported, but economics has not been used as a decision framework incorporating social as well as private values.

124 III

124 ECONOMIC OBSERVATIONS

124 To formulate public policy for strip mining with the objective of increasing the net benefits to society, the place of strip mining in our socio-economic system must be described. The following conclusions, drawn from a variety of sources, seem relevant to an analysis of strip mining in this context.

{125} (1) The day of depletion of the coal minable by surface methods is not at hand, as some have suggested. Technologic advances, manifested in the pit by mammoth shovels, are making it possible to move larger and larger amounts of overburden to reach underlying coal. Furthermore, in thermal generation of electricity, the most important use of coal today, the lower quality coal usually produced at strip mines can be burned as efficiently as the more expensive, higher quality coal produced at underground mines.

125 (2) Under existing economic arrangements coal strip mining is the highest use of most land stripped or sought by strippers. That is, the present value of the time stream of private net revenues from coal production is greater, usually considerably greater, than the market price of that land for any other use. n40 Not only are the per acre returns from coal higher than from other commodities, but they accrue within such a short time that their present value is not greatly diminished by discounting the future. The difference in capital values is indicated by the active market existing for strippable land.

125 n40. Graham, op.cit. supra note 3, at 29-31, 46-51; Guernsey, Strip Coal Mining: A Problem in Conservation, supra note 6, at 178.

125 In other words, both strip mining firms and land owners appear to be making appropriate decisions in terms of the private costs and returns that each must consider. n41 In this framework the long standing argument whether or not strip mines consume land of good, average, or marginal agricultural quality is irrelevant. n42 The same analysis applies whatever the quality of land is involved, though coal companies will presumably have to pay more for higher quality.

125 n41. This is not to say the market is working in ideal fashion. First, the bargaining advantage lies with the coal companies because they have the drilling records. Graham, op.cit. supra note 3, at 50; Guernsey, Strip Coal Mining: A Problem in Conservation, supra note 6, at 178. Moreover, while some farmers may welcome stripping as a way to get their capital out of the farm, others who would prefer to continue farming may be forced to sell because the area loses economies, perhaps in marketing or in the supply of factors, when too much land is withdrawn from farming. Fear of such diseconomies could set up a chain reaction that in effect lowers property values. Guernsey casts some light on these possibilities; id. at 179-81. See also G. H. Walter, Agriculture and Strip Coal Mining, Agricultural Economics Research, Jan. 1949, pp. 26-28.

125 n42. Coal operators have generally held that the land stripped was of marginal quality, whereas others have held that it was of higher quality. Evidence indicates that land stripped is neither largely good nor largely poor land for agricultural purposes. Graham, op.cit. supra note 3, at 43-44; TVA, op.cit. supra note 6, at 5.

125 (3) By private standards the strip mining industry is acting in an efficient manner. Like the exploitation of many other natural resources, the difficulty with coal strip mining is that private standards are not sufficient to define social efficiency. This market failure results because the decisions of strip miners impinge upon other individuals in the economy and affect the miners' production and consumption decisions in ways that are not reflected in their cost calculations. These effects are what economists call technical externalities or external costs. They are of interest not only because they are tangible or intangible costs imposed on others by the mining operation, but more importantly because there is no compensation for such costs and, therefore, no need for the coal operator to control them. They are outside his market calculations - hence the name, external costs - even though they are significant costs to society.

{126} Through the years an almost endless number of ill-effects have been attributed to strip and auger mining. Upon closer examination many of these accusations have been found to be untrue. Other damages, those affecting the sales value of land held by coal companies, should come to be reflected in private decisions. But there are external costs that are real enough, and they form the heart of the strip mining problem. Inasmuch as these costs have been the subject of most of the nontechnical articles about stripping, they need not be discussed here in any detail, n43 but they should be reviewed briefly.

126 n43. For varying appraisals of the importance of these costs, see references cited note 6 supra; also Hannah & Vandervliet, supra note 35. Graham, op.cit. supra note 3, at 52-61, emphasizes the effect of strip mining on tax collections. Several admittedly biased but nevertheless vivid pictorial reviews have also been published. See, e.g., Kentucky's Ravaged Land, Louisville Courier-Journal, Jan. 5, 1964 (special supplement).

126 (a) Air pollution is a relatively minor problem, confined to dust at some pits and to smoke from burning waste piles or coal seams. n44

126 n44. E. Hall, Air Pollution From Coal Refuse Piles, Mining Congress J., Dec. 1962, p. 37.

126 (b) Water pollution, resulting from acid drainage or sedimentation, or both, is much more serious than air pollution. Acid drainage (actually a greater problem with deep mining) occurs as direct run-off from pits and as seepage from auger holes. It is responsible for caking in boilers and for corrosion of boats and bridges at considerable distances downstream from its point of origin. Acid drainage is also responsible for long reaches of some streams that are permanently devoid of fishlife or vegetation and for occasional fish kills in other reaches. Sedimentation, a more serious problem with contour stripping, results from the erosion of spoil banks, denuded hillsides, and access roads. Sediment in streams destroys fish habitat, erodes bridges and roadways, clogs culverts, and aids in undercutting stream banks. It shortens the life of flood control and water storage projects. Both acid drainage and sediment contribute to increased treatment costs for downstream users.

{127} (c) Land problems go hand-in-hand with those of watercourses. The land downslope or downstream of a strip mine may receive eroded material from the mine area.It may become devegetated. In some cases sediment and coal fines have choked stream valleys until the fields become swampy and useless for agriculture. There is some evidence that choked stream beds and the bursting of sedimentbuilt dams are responsible for increased flood, damages. n45 Forest development is often altered and wildlife habitat destroyed; stagnant pools commonly develop in old strip pits, and there are cases in which coal fires have set forest fires.

127 n45. Collier, op.cit. supra note 6, at B-1, B-18. However, W. G. Jones argues that presently used methods of backfilling after strip mining contribute to flood control. He claims that the strip pits themselves act as terraces to prevent rapid runoff and that the backfill is more porous than natural soils and holds more water. Jones, Land Conservation in Pennsylvania Open Pit Mines, Mining Congress J., Oct. 1963, p. 53.

127 (d) Intangible or less measurable effects derive from aesthetic and cultural values that are not directly tied to markets. Important aesthetic effects result from the loss of a natural environment, whatever its original character. Other aesthetic effects result from the absence of vegetation for years on some spoil banks and from the debris remaining after mining. Aesthetically speaking, the small proportion of land actually consumed by strip pits is of less importance than the much larger area over which its effects are visible. n46 Such intangible costs are imposed not only on residents but on visitors traveling through the area. Equally important are the effects on communities near stripping areas. The character of many may be adversely affected by the transient nature of coal strip mining. Tax burdens for those who remain in the area may rise while the level of, or access to, public services declines because people move away or routes of communication are disrupted. Finally, the highwall itself presents a safety problem near built-up areas.

127 n46. The point that stripping consumes a small proportion of the total land surface was relevant when the community was worried about the destruction of agricultural land. It obviously has no relevance when the effects in question occur away from the site of mining. And it is almost equally irrelevant when many recreational uses of land are considered.

127 Some of the external costs discussed above are incurred directly by existing producers of products other than coal and by consumers. The

remainder are represented by local income lost because additional productive opportunities are reduced by stripping. n47 There is no question that income from fishing, tourism, and other recreational activities is reduced while stripping is in progress, and that such income may remain low for years after abandonment of the mine. More questionable are the effects of strip mining on potential industrial development. It is considered important by the Area Redevelopment Administration, n48 and at least one power company has engaged in a reclamation program in the hope of increasing industrial development within its market area. n49

{128} n47. It is not necessarily true that local income losses are net losses to the economy. They may simply be transfers from one region to another. However, given the depressed conditions in many strip mining areas, a case can be made for considering them as net losses.

128 n48. The same approach is implicit in the Appalachia program. The less optimistic side of the argument is carefully presented by Bowman & Haynes, op.cit. supra note 20, at 135-59.

128 n49. Program Drawn To Enhance Landscape, Electical World, Sept. 17, 1962, p. 94. No doubt this motive also underlies in part the TVA's recent interest in strip mine reclamation.

128 (4) Less widely recognized than the external costs of coal strip mining are certain external benefits. That is, in some cases stripping confers benefits on individuals or on the community at large for which the coal company is not recompensed.For example, it has been claimed that men employed in strip mines learn skills more widely used in other industries than are those learned in timbering or in underground mining. n50 Other effects are more tangible. When stripping occurs over old underground mines, the process often collapses the roofs and seals openings so that the flow of acid mine water from the deep mines is reduced or eliminated. n51 It has already been noted that some flood control benefits are claimed. In other cases, strip mining can be an effective way of extinguishing fires in coal seams. n52

128 n50. Graham, op.cit. supra note 3, at 41-42.

128 n51. Jones, supra note 45, at 54, states that strip mining in areas once mined by underground methods has been the greatest single factor in controlling acid drainage in Pennsylvania; see also Jackson, supra note 28, at 89.

128 n52. The Carbondale, Pennsylvania, program is the best known example of controlling a fire by strip mining. However, this case does not qualify as an external benefit because the purpose of fire control was fully recognized in the contract signed between the city and the coal companies. Towns Built Over a Furnace, Business Week, May 4, 1963, p. 98.

128 (5) It is now rather widely held that technologic problems associated with reclaiming strip-mined land have been solved, and that today's problems relate to managing land and making it more productive. n53 As a general statement, this is no doubt true. However, there are areas in which further technical research would probably significantly lower the cost of reclamation. Most of our reclamation knowledge pertains to the relatively flat terrain stripped in Indiana, Illinois, western Kentucky, and elsewhere. Smaller but

still large amounts of strip coal come from the contour mines in the hills of West Virginia, Pennsylvania, eastern Kentucky, and eastern Ohio. These areas are also the home of the auger mine. But there is little research and still less experience to guide reclamation efforts in mountainous terrain. n54

{129} n53. G. S. Bergoffen, A Digest: Strip-Mine Reclamation 22 (U.S. Forest Service 1962); R. F. May, Surface-Mine Reclamation: Continuing Research Challenge, Coal Age, March 1964, p. 98.

129 n54. Bergoffen, op.cit. supra note 53, at iv, 12; Feiss, op.cit. supra note 7, at 9. Actually, much the same statement might be made about reclamation in semi-arid areas, which is not a problem today, though it might become one if lignite is ever mined in large amounts. See Doerr, supra note 38.

129 Additionally, only a small part of the research on reclamation has treated the method of mining as a variable. It has been shown that the tandem system - a method in which a dragline on the edge of the pit removes and segregates the soil and overburden while a shovel in the pit digs the coal - produces better reclamation results but raises the direct cost of mining. n55 However, there have been no systematic studies of the relationships existing between mining methods, reclamation results, and total costs.This probably results from thinking of mining and reclamation as separate stages of production. In contrast, German coal operators have for years incorporated reclamation practices directly into their mining methods. n56 The same approach is being followed at phosphate mines in Florida. n57 In both cases substantial costs savings are claimed over procedures that divorce reclamation from mining.

129 n55. Bergoffen, op.cit. supra note 53, at 26; Limstrom, Forestation of Strip-Mined Land in the Central States 26 (Agricultural Handbook No. 166, Central States Forest Experiment Station 1960).

129 n56. W. Knabe, Methods and Results of Strip-Mine Reclamation in Germany, 64 Ohio J. Science 75 (1964).

129 n57. U. K. Custred, New Mining Methods Rehabilitate Florida's Strip Mines, Mining Engineering, April 1963, p. 50; Land Reclaimers Plan for '68, Chemical Week, Nov. 14, 1964, p. 55. Of course, reclamation in level and semi-tropical Florida is simpler than in the Appalachian or Midwest coal fields.

129 (6) Useful information on the cost of strip mine reclamation and control of acid drainage is not readily available. What has been published is often of little meaning because there is no indication of what is included in the cost figures. Such reported "costs of reclamation" may include anything from piles of spoil bulldozed against the highwall to the development of fields and

forests. Moreover, costs vary with the nature of the terrain, with local employment conditions, and with the purpose for which the land is being reclaimed. Grading costs, perhaps the major variable, are reported to range from 1 1/4 cents per ton to 43 cents per ton (over $1 000 per acre). n58 Nor is it always clear whether "per acre" figures refer to acres actually stripped or acres affected in other ways. Finally, it is impossible to dissociate costs of mining from costs of reclamation in many reported instances.

{130} n58. TVA, An Appraisal of Coal Strip Mining 9 (1963). Cost figures for strip mine reclamation are usually reported in terms of cents per ton or in terms of dollars per acre. One can be converted to the other by assuming that

coal weighs 75 pounds per cubic foot, so that one acre of coal one foot thick (one acre-foot) contains 1600 short tons of coal. If a stripping seam is 3 feet thick, a reclamation cost of $5 0 per acre is roughly equivalent to 1 cent per ton. Typically divergent views on costs in relatively flat terrain can be found in L. Guernsey, The Reclamation of Strip Mined Lands in Western Kentucky, J. Geography, Jan. 1960, p. 11, and in J. Hyslop, Some Present Day Reclamation Problems: An Industrialist's Viewpoint, 64 Ohio J. Science 157, 159-64 (1964).

130 Despite the problems of generalizing about reclamation costs, it is nevertheless useful to have some idea of the magnitude of the costs involved. The most frequently cited cost figure is fifty dollars per acre. This amount is supposed to include a very little grading, some soil preparation, simple erosion control, and planting of tree seedlings; it presumes reasonably flat terrain. In rougher terrain the same figure may be used with the understanding that no grading or soil preparation is included but that greater precautions are taken to ensure correct drainage. Reclamation for purposes other than reforestation is generally more expensive.

130 It is likely that the figure of fifty dollars per acre represents a minimum program serving to avoid the worst effects, rather than an average cost of reclamation. The other extreme is represented in the estimates prepared by a special committee appointed by the Secretary of Agriculture when it was proposed to open a wooded, mountainous area of a national forest to stripping. The committee estimated that the cost of "restoring" mined land to something like its original contour and original forest cover would be $1800 to $3000 per acre, plus $8 00 to $1 500 per acre for land that was disturbed but not actually mined. n59

130 n59. S. T. Dana, The Stearns Case: An Analysis, American Forests, Sept. 1955, p. 44.

130 The minimum figure can apparently be borne by the coal industry, but the

higher figure - assuming the full costs are to be paid by the coal company - would preclude mining. Between these extremes one can find cited almost any cost figure that he considers more representative. My own impressions are that costs of $50 to $2 50 per acre are appropriate for reforestation and pollution control on relatively level land; and that costs in the mountains are unlikely to be less than several hundred dollars per acre, despite claims to the contrary. n60

130 n60. This impression is corroborated by experiments carried out in Pennsylvania. See H. B. Montgomery, Conscientious Coal Stripping, Coal Age, July 1962, p. 87. Additional evidence is found in the fact that costs of establishing timber stands in California after burns or harvesting run close to $100 per acre. See J. R. McGuire, What Are All the Costs of Stand Establishment?, in Economics of Reforestation 3 (Proceedings of the Annual Meeting of the Western Reforestation Coordinating Comm. 1963). The costs reported by the TVA are much lower, but there seems to be an inconsistency between the amount of coal produced and the acreage mined. TVA, op.cit. supra note 58, at 10.

{131} (7) Although time has provided considerable experience, it does not appear that strip mine reclamation has been privately profitable. n61 In the majority of cases the net monetary return to a coal company would be greater if the company could avoid performing any reclamation activities at all. This

does not mean that the returns (from harvesting timber, leasing, charging user fees, etc.) are insufficient to recoup the direct costs of maintaining and paying taxes on the land. But it does mean that the private returns are insufficient to recoup these costs plus the initial investment in reclamation if any reasonable interest rate is charged for the funds. In short, granting that for one reason or another coal companies have decided to reclaim land, they have made the best of the situation; n62 but the costs and returns are not usually such that an outside investor would look at strip mine reclamation as an attractive venture.

131 n61.As a generalization this conclusion is not common. However, it is supported by many studies on particular projects: G. H. Deitschman & R. D. Land, How Strip-Mined Lands Grow Trees Profitably, Coal Age, Dec. 1951, p. 95; P. N. Seastrom, United Electric Coal Companies Land-Use Program, Mining Congress J., Dec. 1963, p. 27; H. Kohnke, The Reclamation of Coal Mine Spoils, in Advances in Agronomy, vol. 2, at 341 (1950); Symposium of Strip-Mine Reclamation, 64 Ohio J. Science 98, 146 passim (1964).

131 n62. Thus, recognizing that coal strip mining is a land use generally incompatible with farming, the companies have turned in most instances to

commercial forestry or commercial grazing. In England, where a very different land situation exists, reclamation of open pit mines has been directed toward the production of cereals. See the series of three articles by W. M. Davies, Bringing Back the Acres, Agriculture, March, April, May 1963.

131 This is in contrast to the position of the reclamation associations and the large coal companies that reclamation is privately profitable. n63 No doubt in special sets of circumstances it is profitable. However, most statements about the "profits" are found on closer examination to include only a comparison of revenue and direct cost, not revenue and total cost. In other cases hidden subsidies are involved, as when a company "loans" the use of its earthmoving equipment to the reclamation project or charges off costs for the replacement of soil as an expense of mining. Rarely is reclamation recognized as an investment process on which discounted net returns should amount to at least a normal profit if reclamation is to be regarded as privately profitable. In the few cases for which there are sufficient data to roughly compute and discount net returns, the results run to less than three per cent per year. n64

132 n63. See Mined-Land Conservation Conference, op.cit. supra note 33, at 3. In support of the industry position, it is often pointed out that reclaimed strip land is worth more, or is more productive, than adjacent non-stripped land. Such statements are evidence of successful physical reclamation but are irrelevant economically because considerable money was spent on the stripped parcel of land, whereas none was spent on the other parcel. Therefore, the time stream of costs as well as of returns is different, and it is not immediately obvious that the stripped land is the more profitable.

132 n64. But one much-quoted figure of $3 .71 profit per year from reforestation implies a return of 6 or 6 1/2%. The figure was apparently estimated by Professor L. A. Holmes and first published in Strip Mine Investigation Comm'n, Report to the 63rd General Assembly of Illinois 24 (1942).

132 (8) Although it is likely that the net private returns from strip mine reclamation are less than a firm could earn from other investments, there is good evidence that over some range the net social returns are high. Social

returns include all the benefits from some action, no matter to whom they accrue, whether or not they can be marketed (as social costs include all the costs of some action, no matter who pays them or whether there is a market for them). To restate my conclusion, the direct returns from reclamation, which could be collected by a public body rather than by a private one, plus the tangible and the intangible returns accruing to others will often considerably exceed the costs of reclamation. Because these latter, non-direct returns - largely but not entirely represented by external costs avoided - are not collectible in the ordinary sense, strip mine reclamation can be socially, but not privately profitable. However, like private investment, social investment must be justified in incremental amounts. It is not enough to know merely that investment in strip mine reclamation is worthwhile in an overall sense. The benefits and the costs of reclamation vary from place to place - and not always in the same direction. Before investing, one should also know where and in what amount investment will yield the greatest net return. The problem presented by comparison of the social benefits of reclamation with the social costs of reclamation is discussed in the next section.

{133} IV

133 THE APPLICATION OF ECONOMICS

133 A. Benefit-Cost Analysis

133 The main burden of this paper is that benefit-cost analysis offers the most useful framework for making decisions about strip mine reclamation.Benefit-cost analysis is essentially the same sort of decision-making process that is used in ordinary market calculations. However, it can be used in situations in which for one reason or another private market calculations do not produce good results, e.g., external costs in strip or auger mining. In either benefit-cost or private market calculations a comparison is made, in monetary measures, between (1) the gains to be realized if some action is taken, and (2) the things that have to be given up in order to take that action. The action is justified if the benefits exceed the costs or, more accurately, if the benefits exceed the costs by a greater amount than for any alternative action.

133 The same benefit-cost principles apply whether operating strip mines are being regulated or abandoned pits are being reclaimed. However, it is simpler to illustrate the latter case. Consider a limited budget of, say $1 000 available for recreational development at three pits. Pit A is near a city; pit B is on rolling farmland well out from the city; and pit C is in the mountains. Because of differences in the availability of construction equipment, in terrain, and in the types of development proposed (playgrounds in the city park, trails in the mountains, etc.), the costs of reclamation, assumed constant at each pit, vary among the pits as follows:

133 Pit A - $200/acre, Pit B - $100/acre, Pit C - $300/acre.

133 Benefits do not remain constant but vary with the amount of land developed. Ignoring for the moment how gross benefits are determined, assume that for three successive acres in each case they are:

	Pit A	Pit B	Pit C
1st acre	$600	$250	600

2nd acre	550	150	400
3rd acre	300	100	200

134 By subtracting the per acre reclamation cost for each of the three acres at each pit, the net benefits are:

134

	Pit A	Pit B	Pit C
1st acre	$400	$150	$300
2nd acre	350	50	100
3rd acre	100	0	-100

134 Costs are lowest for pit B. The "three-acre benefit-cost ratio" is highest for pit A. Neither is a sufficient criterion for optimizing investment.The greatest net social gain can be won by developing the first acre at pit A, the second also at pit A, the third at pit C, and so forth. Thus, some pits may receive extra reclamation funds while others are not reclaimed at all.

134 What are the benefits, and what are the costs of strip mine reclamation? As emphasized above, the main benefits of both regulation and post-mining reclamation are represented by external costs avoided. When corrosion of boats or silting of ponds and streams can be reduced, this is a benefit.In addition, there are benefits from making the land productive. Represented by profits from grazing or tree harvesting, and in recent years, from orchards, homesite construction, or recreation fees, these benefits have often been captured by private owners. Other productive uses are likely to lie within the public sector. Use of strip pits for sanitary dumps is among these. n65 Also with the public sector are certain recreational uses and the production of fish and wildlife, particularly when they are treated as primary products of reclamation, rather than by-products. n66 It has even been suggested that strip pits themselves be used as tourist attractions. n67

134 n65. G. F. Deasy & P. R. Griess, Strip Pits and the Sanitary Landfill Process, Mineral Industries, Nov. 1960, p. 1.

134 n66. The best example of the use of strip mined land for public recreation is Kickapoo State Park in Indiana, part of which was built on strip land. (Indeed, almost every brochure on strip mine reclamation carries a picture of people fishing at Kickapoo Park.) Charles V. Riley of Kent State University has conducted pioneering studies on the use of strip land for wildlife production.

134 n67. P. R. Griess & G. F. Deasy, Economic Impact of a New Pennsylvania

Tourist Facility, 40 Land Econ. 213 (1964); K. L. Bowden & R. L. Meier, Should We Design New "Badlands"?, Landscape Architecture, July 1961, p. 226.Use of the unique character of pits is contemplated in Sweden where architects are making long range redevelopment plans for the iron mines; id. at 228. Similar proposals have been made but never implemented for the Lake Superior iron district of the United States.

134 The costs of strip mine reclamation appear in two stages. Some are incurred after mining is completed and are clearly associated with the reclamation program. When abandoned pits are being reclaimed, all costs are of this type. But operating pits also incur costs because of strip mine regulations and anticipated reclamation activities. Such hidden but, nevertheless, additional costs must also be counted against the benefits of

strip mine reclamation.

{135} By moving directly into illustrations of benefits and costs, an important step has been omitted. It has been implicitly assumed that by evaluating social benefits and social costs in terms of dollars, the social value of proposed actions may be approximated. It is not possible to justify this step here. It is sufficient to say that there is broad agreement that market prices or information on willingness-to-pay (which may consist of surrogate measures in the absence of markets) are socially valid indications of the desires of the members of a community for certain quantities of goods and services. n68 Moreover, prices and willingness-to-pay data provide rational and operational guidelines for investment decisions that will maximize society's gain from the use of its resources. By the same token, public intervention in the market is justified when something interferes with the maximization process. This implies that intervention is costless, which is of course not true; however, in the case of strip mining the costs are probably not excessive when compared with the costs imposed by unregulated market operation. As reflected in benefit-cost analysis, prices provide the tools for making public decisions about strip and auger mining that cannot be provided by such nonoperational slogans as "full reclamation."

135 n68. An extended discussion of the theory underlying benefit-cost analysis can be found in J. V. Krutilla & O. Eckstein, Multiple Purpose River Development 3-77 (Johns Hopkins Press for Resources for the Future, Inc. 1958). A shorter treatment is presented by Allen V. Kneese, Water Pollution: Economic Aspects and Research Needs 18-20 (Resources for the Future, Inc. 1962). R. K. Davis offers a useful discussion of some "conceptual weeds," such as the notion that economic valuation implies commercialization, which can readily be expanded from recreation planning to strip mine reclamation. Davis, Recreation Planning as an Economic Problem, 3 Natural Resources J. 239, 241-44 (1963).

135 B. The Role of Public Policy

135 The first requirement for the systematic use of benefit-cost analysis in public policy toward strip mining is an explicit statement of the social optimum being sought. The appropriate criterion for a social optimum involving strip mining activities is that all costs associated with an optimum level of mining be minimized. This criterion will not be satisfied whenever strip mining imposes costs that are not included in the coal operator's calculations, nor will it be satisfied if cheaper solutions to some problems are feasible but are not open to individual operators.These two conditions, external costs and economies of scale, to use the economist's terms, are the most important general rationales for public intervention. n69

135 n69. F. M. Bator, The Question of Government Spending 76-120 (Harper & Bros. 1960); see also Kneese, op.cit. supra note 68, at 29-32.

{136} Given the criterion for a social optimum, what is the role of public policy when there are uncompensated externalities? Its main role is redistribution of costs in a manner ensuring that those who are responsible for external costs have an incentive to take them into account. Only when costs can no longer be shifted to others in the economy will private costs correspond with social costs and the social optimum be realized. For example, in many areas strip mine operators have no incentive to prevent mine wastes from being picked up and carried off by streams. Because the miner has free use of the water, a

valuable resource, his costs are understated. Simultaneously, a farmer downstream has lower profit from his land because acid and sediment are in the stream. Hence, the farmer's costs are overstated. If the downstream losses are greater than the costs of control at the strip mine, there is a net social loss and society is receiving less from the use of its resources than it could. But if costs are redistributed so that the mine operator must pay compensation to the farmer for damages, this net loss cannot occur. n70 The operator will have an incentive to control the release of sediment and acid to the point at which the added benefits from further control are no longer worth the added expense. If damages remain, it will be cheaper (and socially appropriate) for him simply to compensate the farmer. Once again, net social returns are being maximized. Moreover, they are being maximized by the normal market process in which a private resource owner attempts to minimize his costs. The only difference is that social costs are now made equal and are reflected in his private costs. n71

136 n70. In some states, notably Kentucky, there are legal qualifications to the responsibility of coal operators to pay for damages. Kentucky's Ravaged Land, supra note 43, at 8-9; H. M. Caudill, Night Comes to the Cumberlands

74-75, 305-09 (Atlantic-Little, Brown 1963). These qualifications, upheld by the courts, derive from the contracts by which coal companies obtained mineral rights to the land around the turn of the century. This legal principle does not invalidate the economic principle stated in the text.

136 n71. This process of "internalizing" external effects is discussed at greater length and with more attention to the theoretical underpinnings by Kneese, op.cit. supra note 68, at 20-27.

136 There are several things about this process of cost redistribution that deserve further attention.First, not all external effects are eliminated. To do so would be as much a waste of society's resources as controlling none of them. The social costs of moderate control measures plus some damages will usually be less than the social costs of eliminating all external effects. Similarly, there will be some abandoned pits for which the external costs avoided plus the potential net returns with reclamation will amount to less than the cost of reclamation at that location, and such pits would not optimally be reclaimed. On the other hand, with cost redistribution the scale of mining activities, the "optimum level of mining," will also differ from what it would be with an unregulated market. There are some lands that can be strip mined profitably now because certain costs need not be considered by miners. If the miners of these lands had to bear all the costs of strip mining, the operation would not be profitable and the land would probably remain in its natural state. Finally, social benefits and costs must be computed in net terms. In the example above the social cost of crops lost by pollution is the profit expected from those crops, not their gross value. Similarly, the social benefits of a reclamation program include the profit from the crops saved plus any profit that can be earned from the reclaimed land itself.

{137} Redistribution of costs is the major role that public policy can play in the strip mining problem, but that is not the only role of public policy. It also has a role whenever regional or multipurpose approaches to reclamation can capture economies of scale and thus yield cheaper solutions than could be obtained with mine-by-mine approaches. For instance, it has been shown that large multipurpose dams often achieve a significant reduction in damages from acid drainage through dilution of the acid, n72 though it is an open question whether this method is preferable to mine-by-mine methods. Again, better

reclamation results can often be achieved by coordinated work in larger parcels of land than may be controlled by one operator. The importance of such economies of scale is indicated by the success of coal operators' conservation associations and local soil conservation districts in West Virginia, where the strip mine law permits the miner to contract with them to do his required reclamation. n73 Regional or multipurpose projects introduce additional questions about sharing the costs of the program. For example, it is not obvious how the costs of a regional program for replanting strip land in a depressed area should be distributed among mining firms, direct beneficiaries, and the general public.

137 n72. C. S. Clark, Mine Acid Formation and Mine Acid Pollution Control, Paper Delivered to the Fifth Annual Symposium on Industrial Waste Control, Frostburg State College, Frostburg, Md., May 7, 1964 (to be published in the Proceedings of the Symposium).

137 n73. E. Leadbetter, There Oughta Be a Law, Soil Conservation, Sept. 1957, p. 36.

{137} Finally, the time dimension of strip mine reclamation deserves mention. Many of the damages from strip mining are temporary. An important aspect of benefit-cost analysis is to determine when the costs imposed by temporary losses or temporary ugliness are greater than benefits that may become negligible in a fairly short time. If a strip mine will reforest itself in five or ten years, it would no longer be correct to assign benefits to the reclamation program after that time. Should reclamation be left to nature in such a case? In some cases this might be appropriate action, but if this were the only area near a city for fishing or hiking, then even a temporary loss might impose large costs. Acid mine drainage presents a particular problem in this regard because its effects are so persistent. It has been reported that a stream may require thirty months for restoration after concentrated acid has flowed for barely one hour. n74 That is, the damages are much less reversible than are damages from other pollutants. Consequently, the importance of keeping acid out of streams or of maintaining adequate dilution flows at all seasons of the year becomes critical.

137 n74. G. D. Beal, Common Fallacies About Acid Mine Water 4 (Sanitary Water Bd., Pa. Dep't of Health 1953) (mino.).

137 The reclamation program can also be designed to serve varying purposes during the passage of time. It has been persuasively argued, for example, that too much emphasis has been placed on reclaiming land in ways that lead directly to marketable products. A socially preferable procedure may be to make the initial goal one of obtaining cover on the bare soil and eliminating the ugliest aspects of the scar. Later phases of the program may then be devoted to commercial forestry or other profitable pursuits. n75 In any event, the sequence of reclamation activities is another variant in the search for the optimal reclamation program.

137 n75. Bergoffen, op.cit. supra note 53, at 21-22; F. W. Collins, Triple-Phase StripMine Reclamation (Div. of Strip Mine Reclamation, Ky. Dep't of Conservation) (undated).

137 C. Evaluation

137 Thus far statements about benefits and costs have been made as though it were possible to evaluate them simply and accurately. This is, of course, far from the truth. They can be exceedingly difficult to evaluate. However, there are many benefits and costs whose market prices can be directly incorporated into the analysis. Value of timber produced, cost of seedlings, and fees collected are a few of those regularly used in evaluating government projects. There are other benefits and costs that can be evaluated indirectly, though no market exists for the particular benefit or cost in question. n76 In these cases values can be imputed by substituting market prices that do exist. For example, in a Public Health Service study, the amount of money spent each year because of mine acid-induced corrosion of boats and marine structures, caking of boilers, and added treatment by industries downstream was calculated. The annual value imputed to acid drainage control was then the amount of these costs that would be avoided each year. n77 Flood damages, erosion damages, and other costs imposed by strip mining could be evaluated in the same way. Moreover, there are still other costs and benefits, once thought to be unmeasurable, that are proving at least partly tractable to analysis.Recreation is the most important of these. n78 It would seem entirely feasible today to use one of these techniques and the information available on the costs of different types of recreational sites to make a benefit-cost calculation of the net benefits of reclaiming strip land for recreational use.

137 n76.A. V. Kneese, Socio-Economic Aspects of Water Quality Management, 36 J. Water Pollution Control Federation 257 (1964).

137 n77. U.S. Public Health Service, Acid Mine Drainage Studies, in Ohio River Pollution Control 973-1023 (Supplement C to Part II, 1944).

137 n78. J. L. Knetsch, Outdoor Recreation Demands and Benefits, 39 Land Econ. 387 (1963); Davis, supra note 68.

{139} There will remain, however, benefits and costs that are presently unmcasurable, and whose absolute values may be in principle unmeasurable. But this does not mean that these effects must be completely excluded from benefit-cost analysis. Kneese has suggested that the best way of handling "socially valid goals for which for one or another reason there are no values commensurable with the values pertaining to other elements of the system" is to treat them as explicit requirements in any proposed program. n79 Referring to water pollution control programs, he states:

139 This can be done by initially treating these goals, expressed in

physical terms, as limits or constraints upon the cost minimization objective . . . Conceivably this would require a very different combination of units with different operating procedures than a system designed without the constraints. Presuming the constraints are effective, i.e., not automatically met if costs are minimized, they would result in a higher cost system than could otherwise have been achieved. The extra cost represents the limitation which the constraint places upon the objective. n80

{140} For example, it might be decided that for aesthetic reasons stripped land will remain denuded for no longer than one year. To accomplish this it may be necessary to save and replace topsoil, to do more soil preparation, or to avoid mining in certain sites. All of these procedures would increase the cost of the mining-reclamation process.

140 n79. Kneese, Socio-Economic Aspects of Water Quality Management, supra note 76, at 258.

140 n80. Kneese, Water Pollution: Economic Aspects and Research Needs, op.cit. supra note 68, at 32-33, 42-44.

140 This method of making social goals explicit has the further advantage that it permits us to calculate their minimum value. It has been stated by Kneese:

140 One useful way of stating the results of variation of constraints which represent goals . . . not valued directly by, or imputable from, the market . . . is in terms of what they must 'at least be worth.' . . . [By] comparing the optimum system with and without the constraint, it is possible to indicate what the least value is that must be attached to the increment of pleasure in order to make that level of control procedures worth while. n81

140 In short, we are in fact putting a monetary valuation on aesthetic or social goals whether or not we like to think of it that way.

140 n81. Id. at 34-35.

140 Actually this point is quite general and worth emphasizing. Any restriction or regulation that is placed on the processes of strip and auger mining (or anything else) implies an evaluation. Each has an economic cost that can be made explicit, and one must be able to argue that the social benefits to be gained by imposition of the requirement are worth at least this much.

140 D. Methods and Techniques

140 In the two preceding sections some principles of benefit-cost analysis and its application to strip and auger mining have been discussed in general terms. The final step in this preliminary assessment of the role of economics is to offer suggestions about how one might actually base decisions on benefits and costs. At this point it becomes convenient to separate the problem of regulating existing strip mines from that of reclaiming abandoned ones.

{141} What methods are available for making benefit-cost calculations for reclamation of abandoned strip pits? The most promising approach is the method now coming into use for determining the social value of soil conservation projects. n82 These techniques require careful estimation of expected returns over time and clear recognition of the principle that reclamation must be justified on investment criteria. The data needed, but not presently available, to make these analyses include expected returns from different types and different sequences of reclamation activities on strip mined land of varying qualities and different locations. (Changes in land values may be a clue here.) Additionally, it would be essential to systematically collect data on the external costs of strip mining and to estimate the present value of future damages avoided. Some information of this type may come out of the cooperative study on acid drainage in several river basins in the northern coal fields of West Virginia recently begun by the United States Public Health Service and the West Virginia Bureau of Mines. In the same project various methods of coping with acid drainage will be compared, careful cost accounts being kept for each. The same approach could be fruitfully applied to an area in which the whole set of problems associated with strip mining is at issue.

141 n82. A. J. Coutu, W. W. McPherson & L. R. Martin, Methods for an Economic Evaluation of Soil Conservation Practices (Tech. Bull. No. 137, N.C. Agricultural Experiment Station 1959); R. N. S. Harris, G. S. Tolley & A. J. Coutu, Cropland Reversion in the South 61-69 (Agricultural Economics Information Series No. 100, N.C. State College 1963). See also certain of the papers in Economics of Reforestation, op.cit. supra note 60.

141 With such data in hand it would be possible to adapt the techniques applied in soil conservation projects (which already include both direct returns and external costs avoided as benefits) to strip mine reclamation proposals.The problem is essentially no different. Moreover, the method is flexible. It would be possible to use a lower rate of interest for funds loaned in a depressed area; in areas where aesthetic valeus are high, limits on the depth or location of strip mining could be imposed as constraints on cost minimization.

141 When one turns to the more difficult problem of regulating existing mines, he finds that none of the seven state laws presently in force are adequate to handle the range of problems presented by strip and auger mining.

n83 Most laws do not recognize that conditions vary, hence that external costs vary, within the state. Nor do these laws recognize that both reclamation costs and potential benefits vary with location and terrain conditions. The differences between area stripping and contour stripping are usually ignored. Regulations are applied across-the-board. For example, almost all of the laws impose a single standard for the grading of stripped land and spoil piles. Actually, the appropriate kind and degree of grading depends upon the terrain, adjacent land use, and proposed use of the reclaimed land. Professors Deasy and Griess have specifically urged laws designed to foster selective and local modification of the terrain, without major remodeling of the entire surface, [thereby permitting] development, at reasonable cost, of the widest variety, frequently aesthetically most pleasing, and on the whole economically most profitable types of highly specialized land usage - recreation, education, water conservation and waste disposal. n84

142 On the other hand, a useful feature of some laws is their provision for substitution of land. Rather than reclaim land now being mined, an operator may elect to reclaim an equal number of acres of land not previously reclaimed. Although open to possible abuse, substitution does permit the reclamation effort to be concentrated on land that will return greater net benefits. It is not difficult to think of other techniques for concentrating the effort, possibly making it more efficient physically as well as economically. n85

142 n83. Detailed comment on these laws is given by Meiners, Strip Mining Legislation, 3 Natural Resources J. 442 (1964), and a summary of their provisions is given by Bergoffen, op.cit. supra note 53, at 26-42. The laws of individual states are generally reviewed in detail in law journals shortly after passage or amendment.

142 n84. Deasy & Griess, Coal Strip Mine Reclamation, supra note 39, at 1. On the other hand, Meiners, supra note 83, at 449 passim, attacks the laws for being too flexible. He seems to view every permissible relaxation of regulation as an unwarranted gift to the strip miner. But in economic terms rigid restrictions, rigidly enforced, may have no more to offer than administrative simplicity. However, Meiners is certainly correct when he argues that whatever the flexibility permitted by law, it is poor practice to allow the mining company alone to determine the degree to which the law will be applied, as is

done in some states.

142 n85. The West Virginia practice of allowing soil conservation districts to contract with coal operators to perform required reclamation is one such technique.

142 There is no need to belabor the point. The few instances cited indicate that much could be done to make existing strip mine legislation and its enforcement a more effective tool for reducing social costs by requiring certain practices of strip miners and by creating conditions under which socially more profitable reclamation procedures can be followed.

142 Perhaps there has been altogether too much reliance on control of strip and auger mining by legislative regulations. For existing operations other techniques may be applicable. In the field of water quality management, techniques such as zoning, effluent standards, and effluent charges have been successfully used to redistribute external costs. n86 Effluent standards are implied by Pennsylvania's "Experimental Rules and Regulations for the Operation and Maintenance of Strip Mines." n87 The rules provide that acid in drainage shall be reduced as close to zero as possible in the outflow and that the iron content shall not be so high that it precipitates as "yellow boy" on the stream bottom. The rules also suggest that hillsides be zoned so that certain areas, notably water courses, be left unstripped. Similarly, the Stearns case decision, in which a specially convened board refused to permit stripping in Cumberland National Forest, was a zoning decision. n88 The Stearns decision was based not on the fact that the land was public land, but upon the hilly and forested character of that land. It was pointed out that the social costs of stripping would be much greater than the net value of the coal produced. And there was no reason to think that the coal under this land was of any greater value than coal that could be mined without such large social costs. Thus, this decision is not in conflict with other decisions permitting stripping in other national forests where conditions differ. Although rather broadbrush zoning to prevent stripping has been held unconstitutional, n89 there is no reason to think that zoning based on an evaluation of social costs would be so held.

142 n86. A.V. Kneese, WateerQuality Management by Regional Authorities in the Ruhr Arca, with Special Emphasis on the Role of Cost Assessment, in Proceedings of the 1962 Meeting of the Regional Science Association (in press). See also other papers by Kneese for elaboration on the use of these techniques.

142 n87. Sanitary Water Bd., Pa. Dep't of Health, Experimental Rules and Regulations for the Operation and Maintenance of Strip Mines to Prevent Pollution of Waters of the Commonwealth (1952) (mimeo.). The ORSANCO acid drainage control program is similar; see Raleigh, Acid-Drainage Curbs Are Ilere, Coal Age, April 1960, p. 80.

142 n88. Dana, supra note 59.There was an additional legal question in this case involving mineral rights reserved when the land was taken into the national forest. However, the board was instructed not to consider this question but only to evaluate the long term public interest.

142 n89. G.D. Sullivan, Presentation before the Mineral and Natural

Resources Law Section, American Bar Association, Chicago, Aug. 12, 1963, pp. 11-12 (mimeo.).

{143} The bonding system, common to all seven state laws, shows great promise as a device to redistribute costs to bring private and social costs in line. These bonds are required of strip miners before they begin operations and are released upon the completion of specified reclamation activities. Unfortunately, there is little evidence that the bonding system is being used as a device to direct reclamation along the socially most efficient path. Rather it is viewed only as a club over the heads of the operators, and with lax administration it need not be a very heavy club. First, the amount of the bond is usually fixed by law. It is not varied with the character of the land, the proposed method of mining, the nature of the reclamation problem, or the past performance of the coal operator. Second, there is no attempt to use the bonds as a device to gather blocks of land into planned reclamation areas. One strip pit could be reclaimed for forest, the adjacent pit for meadow. Third, in many cases the bonds are set so low that it is cheaper to forfeit than to perform any reclamation. Finally, the bond is usually returned on the basis of certain activities, not on the basis of certain accomplishments. The fact of seeding, not of growth, is sufficient to have the bond released. In short, there is little economic rationale for the amount of the bonds or for their terms as they are used today. If, instead, the bonds were set according to some benefit-cost guidelines taking into account the nature and beauty of the terrain, proximity to urban areas, the time required for natural revegetation, and alternative uses of the land, among other things, the net benefits to society from the whole strip mining process would be significantly increased.

{144} All of the methods suggested to achieve a socially preferable allocation of resources would require more complex administrative procedures than do the current across-the-board rules. Public intervention is never costless. The justification for the added administrative costs lies in the social gains that can justifiably be expected from the application of economic concepts to the problems created by strip and auger mining. Finally, there is every reason to think that the strip mining industry could accommodate itself to a new regime. It is a remarkably resilient industry that has taken many other problems in its stride. With further research it may appear that the socially optimal position is not so privately expensive after all.

144 CONCLUSION

144 This is an opportune time to review the problems associated with strip and auger mining for coal. Public concern is high, and this concern derives increasingly from the desires of numerous individuals and groups residing in urban areas, rather than from those few whose interests are directly affected.

The legislatures of a number of states have considered new or amended strip mine laws in the past year or two. Such legislative proposals invariably generate even broader public interest. The chairman of the mineral law section of the Pennsylvania Bar Association noted that the 1963 amendments to the strip mine laws of that state were "the single, most controversial piece of legislation of the past decade." n90

144 n90. D.B. Dixon, Report of the Mineral Law Section, 34 Pa. Bar Ass'n Q. 456, 457 (1963).

{145} With passage of the Appalachian Region Development Act of 1965, n91 strip mining has become for the first time an explicit concern of the federal government. This federal concern is potentially the most important development for solution of the problems of strip and auger mining. The act authorizes

the spending of funds to cope with the effects of both surface and deep mining. Indeed, President Johnson, upon the insistence of Governor Scranton, agreed to substantially more funds than had originally been proposed. n92 Additionally, Senator Lausche's perennial bill to authorize a federal study of strip mining, which in other years had aroused vehement opposition and had never passed out of committee, was incorporated almost completely in the act as one of the few sections made applicable to the entire country rather than solely to Appalachia. n93 The importance of this new federal involvement in relating the problems of local and Appalachia is reflected in the strong positions taken outside of government. At one end are those who see an expanding coal industry, largely by means of strip and auger mining, as the key to Appalachian redevelopment. At the other end are those, like Harry Caudill, who claim that the social costs of strip mining in the mountains are so high that it should be completely prohibited. n94

145 n91. 79 Stat. 5 (1965) [Pub.L. No. 89-4, 89th Cong., 1st Sess. (March 9, 1965)].

145 n92. Washington Post, April 23, 1964, p. A-6, col. 1, and April 29, 1964, p. A-11, col. 1.

145 n93. Pub.L. No. 89-4, @ 205(c), U.S. Code Cong. & Ad. News, March 20, 1965, pp. 100-01.

145 Struck by the inconsistency of proceeding simultaneously with reclamation and with a study of how best to go about it, Senator Lausche succeeded in having the Appalachian Bill amended to provide that no federal funds be spent to restore privately owned strip land, pending completion of the study. Immediate reclamation of public land is permitted. Pub.L.No. 89-4, @

205(d), id. at 102. (This amendment to the bill was one of two passed on the floor of Congress. Washington Post, Feb 2, 1965, p. A-4, col. 2.)

145 Some work on the application of benefit-cost analysis had already been started in the Department of the Interior. Interview With E.H. Montgomery, Resources Program Staff, Dep't of the Interior, June 3, 1964.

145 n94. H.M. Caudill, Appalachia: Path From Disaster, The Nation, March 9, 1964, p. 240. The special supplement to The Courier-Journal stated that such a prohibition would be ideal, but that it was unattainable. Kentucky's Ravaged Land, Louisville Courier-Journal, Jan. 5, 1964, p. 13 (special supplement). See also Knabe, supra note 56, at 141-42.

145 With interest focused on strip mining from a number of sources, there is danger that the desire for action will foster uneconomic or inconsistent programs. The problem is basically one of allocation of resources. An unregulated market will not produce a socially optimal allocation because of technical externalities. The purpose of this paper has been to indicate that a rational public approach to this problem, based on benefit-cost analysis, is within the capabilities of our analytic methods. Three different but interrelated goals have been implied, goals that may complement or oppose the others. n95 The first goal is national productivity, maximization of the net value of output from the resources that society puts into production. This goal is presumably approached by firms operating through the market system in response to free consumer choice. However, it is also this goal that requires government intervention to minimize the total of all costs associated with an

optimum level of strip and auger mining whenever (1) costs associated with mining need not be considered by miners, or (2) a regional or multipurpose reclamation program would be more efficient than a mine-by-mine approach.

145 n95. Bowman and Haynes outline policy criteria for eastern Kentucky in terms of a set of goals, and I have drawn upon their formulation. Bowman & Haynes, Resources and People in East Kentucky 259-66 (Johns Hopkins Press for Resources for the Future, Inc. 1963).

{146} The second goal includes cultural and aesthetic values that cannot, for one reason or another, be put directly into the cost minimizing calculation. They are represented by constraints on the ssytem forcing it away from the minimum cost point. The implication is that added benefits received are greater than added costs incurred. The importance of this quality of the environment goal is increasing. A substantial proportion of the public seems to be opting for beauty, or at least for the absence of ugliness.

146 The third goal for programs of strip mine reclamation is redistribution of income to individuals in stripped areas whenever these areas fall within the scope of the poverty program. For our purposes, this goal can be narrowed to local employment. If local employment in certain areas is accepted as a benefit, it follows that the "cost" of certain reclamation projects will be reduced to the extent that men who would otherwise be unemployed will secure jobs. On the other hand, if action directed to other goals reduces the amount of mining in some areas, an important conflict that must be resolved develops among the goals. Again, this goal of redistribution of income is real because the public seems to be opting for the elevation of poverty stricken areas.

146 The three goals of national productivity, quality of the environment, and local employment together represent a rationale for public policy on strip and auger mining. By the use of benefit-cost analysis conducted under constraints, an explicit and flexible framework becomes available for considering both regulation of existing surface mines and reclamation of the "orphan pits" abandoned in earlier years. Unfortunately, we are still a long way from having the data necessary to make such analyses. If the primary purpose of this paper is to emphasize the applicability of economic analysis to strip and auger mining, its secondary purpose is to indicate the lack of appropriate data and to stimulate the collection of it.

{148} [From Natural Resources Journal, Jan. 1971]

SELECTED READINGS

ECONOMICS

A MEASUREMENT OF THE EXTERNAL DISECONOMIES ASSOCIATED WITH BITUMINOUS COAL SURFACE MINING, EASTERN KENTUCKY, 1962-1967

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148 * The author is Assistant Professor of Economics, Auburn University. He acknowledges the assistance of Professor C.L. Christenson, Indiana University, in the research which is the basis for this article. Acknowledgment is also made of the research fellowship provided by the U.S. Department of the Interior. In addition, valuable suggestions were made by the referee.

148 The purpose of this article is to suggest an [*] both the assumed external diseconomies arising from [*] and the internal expenses incurred by firms to reduce [*] costs. These internal expenses are associated with reclaiming the surface-mined land. The term "external diseconomies" or social costs as used herein refers to all of those damages and harmful effects sustained by others as a result of productive processes, and for which the

private firms are not held accountable; in addition, such costs must be avoidable and shifted to other persons or society in general. The various types of external diseconomies arising from each of the several sources within the mining site are claculated separately; charges to be incurred in future years are discounted to the year in which surface mining takes place. When further reclamation is performed, the average internal expenses and the average external costs are computed and compared.

148 For the purpose of exploring this approach, an examination is made herein of the internal expenses and assumed external diseconomies associated with the eastern Kentucky bituminous coal surface mining industry during the 1962-1967 period. The changes over this six-year period in the Kentucky law and regulations concerning the reclaiming of land disturbed by such surface mining n1 caused significant reductions in external costs imposed upon society in the form of damages from acid run-off water, silt and sediment material, landslides, losses by owners of the land surface only, and loss of aesthetic values. The more notable alterations in the reclamation provisions and their enforcement occurred in 1964 and 1966. These revisions changed the magnitude of each external cost source and its duration. In addition, the changes in reclamation requirements and enforcement procedures increased the mining firms' internal mining expenses.

148 n1. Unless otherwise, indicated, the term "surface mining" as used herein refers to eastern Kentucky bituminous coal surface mining (auger plus strip).

{149} External cost decreases and internal mining expense increases for the 1962-1967 period are computed and compared both on a [*] acre and a per-ton-mined basis. This period is chosen in order to determined such annual costs before and after the 1964 as well as the 1966 revisions in reclamation procedures and enforcement. The specific external costs examined are: n2

149 Damages from acid run-off water

149 Damages from silt and sediment materials

149 Loss of aesthetic values

149 Losses incurred by owners of the land surface only

149 Losses caused by landslides

149 The calculated internal costs of the mining firms to perform the land reclamation include:

149 Direct reclamation costs (land regrading and revegetation).

149 State surface-mining permit and acreage fees.

149 Performance bond fees.

149 Other administrative costs.

149 The approach utilized herein may be useful in analyzing the costs and benefits associated with surface mining other than bituminous coal.

149 n2. It is recognized that other external costs exist such as the damage to society by dust among from the mining operations and from coal truck traffic, and damages to public roads and bridges by coal trucks above their share of road taxes. However, these external costs are but within the purview of the state law. In addition, the creation of some comparatively weel land in the mountaineous terrain of eastern Kentucky may be considered as an offwlling benefit arising from surface mining. These other possible damages and benefits are not measured herein. In addition, the lower industrial accident rate may be cited as a benefit of surface compared to underground mining; however, the difference would not correctly be included as a benefit in this analysis. These differential accident rates would appropriately is considered in an examination of the comparative costs and benefits of all sources of fuel coal, oil, gas, nuclear, hydro, and solar.

149 I THE METHOD OF MEASUREMENT

149 A. Types and Sources of External Costs

149 The basic objectives of the Kentucky reclamation requirements are:

149 1. Reduction of external diseconomies caused by acid-run-off water.

149 Sulfuritic minerals in the material in and around the coal seam are exposed during the mining process. These substances are carried from the mining site by storm run-off water. The pollution of streams and rivers by these minerals corrodes bridge supports, increases the cost of processing water for both domestic and industrial use, kills fish, and decreases the aesthetic values of streams and lakes. Acid water originates in three different areas of a contour mining site in eastern Kentucky.These areas are labeled "A" "B" and "C" in Figure 1.

{150} [See Graph in Original]

150 2. Reduction of external diseconomies caused by sediment material flowing from the mining site.

150 Silt material is carried from the mining site by run-off water into surrounding streams and bodies of water. This sediment reduces the water-carrying ability of streams and the storage capacity of lakes and reservoirs. n3 The basic sources of this silt material are areas "B" and "C" in Figure 1.

150 n3. At the same time, it is recognized that a reduction of the water run-off rate in some tributaries may be beneficial.

150 3. Reduction of other external diseconomies.

150 Surface mining removes the vegetative cover of the land and causes some loss of aesthetic values. Owners of the land surface only may receive from the mining firms a relatively reduced amount of compensation because of the provisions of the broad form land deed. n4 The mining process may entail additional external charges such as damages from landslides.

150 n4. This type of land deed, used extensively in eastern Kentucky, separates the surface and the mineral rights. Several aspects of this land deed are further discussed below.

{151} B. Acres Disturbed by Surface Mining

151 In the years prior to 1966, the land measurements submitted in surface mining permit applications were not computed according to any common standard. Such measurements were probably more accurate from 1964 than in earlier years, since commencing in this year the mining areas were surveyed by professional engineers. However, in 1966 and 1967 the acreage was determined by a standard formula promulgated by the Kentucky Reclamation Division (Kentucky Department of Natural Resources). Comments by personnel of the Division in 1968 indicate that the actual acreage disturbed by surface mining was grossly understated in permits issued in earlier years. Therefore, the acres disturbed in 1966 are used herein as a standard for the calculation of such acreage in other years. Table 1 shows the acres considered disturbed during 1962-1967 and also an example of the method of acreage calculation utilizing the 1966 permitted acreage as a standard.

151 C. Discounting of Specific External Costs

151 The procedure for measuring some external costs involves the deduction

of the share originating in eastern Kentucky surface mining sites from the total of such costs which arose from all bituminous coal mining in the Appalachian region. The total cost figures utilized are those estimated by the U.S. Public Health Service (references are shown in Table 2). Other costs are those contained within eastern Kentucky, such as those imposed upon land surface owners only. All costs are assigned on a per-disturbed-acre basis, and some costs are further allotted to each part of the mining site, such as acid run-off water from only the downslope of the removed overburden. Costs from all sources are summed and computed for the year of mining and future periods. Costs incurred in future years are discounted to the year of mining.

151 The suggested measurements include:

151 the external costs originating from a period's surface mining operations - this period's charges plus those of future periods;

{152}

TABLE

Data Utilized in the Determination of Actual Acres of Land Disturbed by Bituminous Coal Surface Mining in Eastern Kentucky,1962-1967

(1) Year n1	(2) Average Seam Thickness Stripped n2 (ft)	(3) Average Seam Thickness Augered n3 (ft)	(4) Average Seam Thickness n4 (ft)	(5) Tons Per Acre n5	(6) Total Surface Productio n n6	(7) Total Acres Disturbed n7	(8) Tons Per Acre Disturbed
1962	3.5	4.1	3.8	6,840	6,390,836	3,364	1,900
1963	3.7	4.2	3.95	7,110	6,993,194	3,541	1,975
1964	4.0	4.2	4.1	7,380	7,626,482	3,720	2,050
1965	4.3	4.3	4.3	7,740	9,587,626	4,459	2,150
1966	4.4	4.4	4.4	7,920	9,711,238	4,414	2,200
1967	4.5	4.4	4.45	8,010	11,352,004	5,102	2,225

[See Table in Original]

152 n1 Calendar years.

152 n2 and n3 Average seam thickness for 1965 is from U.S. Bureau of Mines Information Circular 8345, W. H. Young, Thickness of Bituminous Coal and Lignite Seams Mined in 1965, (August, 1967); seam thicknesses for 1962 through 1964 determined by interpolation (utilizing data for 1960 and 1965); seam thicknesses for 1966 and 1967 determined by extrapolation and estimates by mining engineer, Kentucky Department of Mines and Minerals.

152 n4 Average thickness determined by an average of the strip and auger thicknesses, since approximately one-half of eastern Kentucky surface tonnage is produced by each method of mining.

152 n5 Calculated on the basis of 1,800 tons per acre foot of coal and 100 percent recovery.

152 n6 Data from Annual Reports of Kentucky Department of Mines and Minerals for the period covered.

152 n7 Actual acres disturbed including coal-haul roads according to the standard used in 1966 by the Kentucky Reclamation Division. The acres hewly promuled in 1966 plus the acres renewed in 1966 minus the acres renewed in 1967 equal 4,414 acres, the number considered disturbed in 1966. The total production for 1966, divided by 4,414 acres equals 2,200 tons produced for each acre disturbed. The tonnage from an acre of coal in 1966 equals 7,920 and divided by 2,200 equals 3.6 acres disturbed for each acre of coal.Using this standard of 3.6 acres, the total acres disturbed for any other year may be determined. For example, in 1963: total production of 6,993,194 tons divided by 7,110 tons equals 983.57 acres of coal; the acres of coal multiplied by the standard of 3.6 equals 3,541 acres disturbed.

152 changes in these external costs caused by natural forces and by land reclamation requirements.

152 The specific costs for the 1962-1967 period, symbolically, are:

152 The amount of external costs from surface mining operations in time period t caused by acid run-off water,

152 Act = from the coal face, auger holes, and breakthroughs of underground mines.

152 Amt = from the mining and fill bench.

152 Ast = from the downslope of the removed overburden (spoil bank).

152 At = Act + Amt + Ast

{153} The amount of external costs from surface mining operations in time period t caused by silt material,

153 Smt = from the mining and fill bench.

153 Sst = from the downslope of the removed overburden (spoil bank).

153 $S_t = S_{mt} + S_{st}$

153 B_t = The amount of external costs from surface mining operations in time period t caused by the loss of aesthetic values at the mining sites by the general public.

153 O_t = The amount of external costs from surface mining operations in time period t imposed upon owners of the land surface only.

153 L_t = The amount of external costs from surface mining operations in time period t caused by landslides. These costs are in addition to any additional acid water and silt damages caused by landslides.

153 The total external costs from surface mining operations in time period t,

153 (1) $E_t = A_t + S_t + B_t + O_t + L_t$

153 is a product of the number of acres disturbed and the charge per acre. For example:

153 N_t = The number of acres disturbed in period t.

153 C_t = The dollar amount of external cost per disturbed acre from surface mining operations in time period t, caused by acid run-off water from the coal face, auger holes, and breakthroughs of underground mines.

153 (2) $A_{ct} = N_t C_t$

153 Even if no changes in the land reclamation requirements take place, it must be recognized that nature causes some of the external costs to change over time. For example, the acids in the overburden leach out over time, fallen material from above the coal seam may gradually cover the face of the coal seam, and vegetation spreads to disturbed land from the surrounding area. Thus, the physical amount of acid pollution, for instance, may decrease over several years. Therefore, C_t must also reflect any changes in costs resulting from natural causes.

153 (3) $C'_t = C_{ot} (a_{0t} + a_{1t} + \ldots a_{nt}) = C_{ot}$ [*ait (n = number of the year in which a_n = O) = Total external costs per disturbed acre for acres disturbed in period t and including costs arising in future years (but not discounted).

{154} The value of the coefficient "a" is assigned for each time period. For example, the total costs from this source for the mining which took place in 1963 is computed by assigning the following values to the coefficients. n5

154 n5. The values of the coefficients and the time spans were determined in consultation with personnel of the Kentucky Reclamation Division, Kentucky Reclamation Association, Water Resource Center, Indiana University, and others.

154 a0 = 1.0 a2 = .4 a4 = .2 a6 = 0.0

154 a1 = .6 a3 = .3 a5 = .1

154 (4) C'1963 = $4.59 (1. + .6 + .4 + .3 + .2 + .1 + 0) = $11.934

154 And where N1963 = 3,541 acres,

154 (5) Ac1963 = $42,258.29 (not discounted).

154 The purpose of reclamation requirements is to reduce the amount of the external diseconomies; therefore, these restraints have the objective of reducing the values of the coefficients. For example, more complete coverage of the coal face and auger holes would reduce the value of "a" for each time period. In addition, the time span may be shortened and cause at to become zero at an earlier period.

154 Future costs associated with any period's coal production should be discounted to the base period. But what rate of discount should be used? If the mining firm is forced by law to incur all external costs, it could either pay these costs as they occur each year or establish a sinking fund. In the former case the future costs should correctly be discounted at a rate appropriate for a mining firm. The U.S. Department of Interior recommends a rate of twelve percent to represent mineral industry expectations for normal risk undertakings. n6 The use of this rate would assume that the firm earns twelve percent on its funds and pays the external costs in each future period. The second possibility would assume that the firm establishes in the period of mining a sinking fund of a sufficient amount to cover all future costs. If such a fund is invested in Government bonds, for example, the appropriate discount rate should be utilized.

154 n6. U.S. Bureau of Mines, Div. of Economic Analysis, Economic Advice No. 15, Economic Valuation of Mineral Resources (1968).

{155} An alternative to these two methods of calculating the present value of future costs is to assume that each other firm or segment of society incurring these external charges has its own discount rate. The present value of future charges would then be calculated using a multitude of discount rates. Thus, firm "A" which incurs certain costs due to acid water pollution would be reimbursed an amount in the year of mining to cover all of its future costs from this source of pollution. In this case, the present value of these future costs would be discounted at the rate appropriate for firm "A" and not the mining firm. An additional alternative would be that the mining firm would place funds in some other economic endeavor which would return more than twelve percent. In this case, the external charges would be discounted at this higher rate. However, we must assume that the mining of coal represents the best opportunity available to the firm for the investment of its funds, otherwise, it would be engaged in the other economic activity with the higher return.

155 The intent of the Kentucky reclamation law and regulations is to reduce or eliminate these external charges by prescribing certain land reclamation, rather than by requiring direct reimbursement to other parties or public agencies.However, either method would minimize losses of these external parties. Reimbursement may be considered as the estimated maximum net cost chargeable to the mining firm. Therefore, the rate of twelve percent is considered appropriate for the calculation of the present value of future costs.

155 Equation (5) must therefore be extended to include the discounting of future costs.

155 r = discount rate. [*]

155 = Ct discounted.

155 Thus, the present value of the total external cost from Source Ac arising from the 1963 surface mining operations, where r = 12 percent,

155 C 1963 = $10.336

155 Ac 1963 = $36,599.78 (Instead of the undiscounted amount of $4 2,258.29.)

155 II

155 EXTERNAL COSTS

155 A. Source A - Acid Run-Off Water

155 Table 2 depicts the data for the computation of the external costs

arising from this type of water pollution.The cost of $11.466 per

TABLE 2 Data Utilized in the Determination of Total External Costs Arising
From Acid Mine Run-off Water From Eastern Kentucky Bituminous
Coal Surface Mining; 1962- 1967
(Ct)Cost Per Acre Disturb When ed (the Present

Base Value
Year in Base The Time Periods The Value of the Coefficients Dollar Valuc
(t) is: Year) Ciscounted to Base Year at 12 percent
For Ac
(From
Coal
Face,
Auger a0 a1 a2 a3 a4 a5 a6 a7
Holes,
and
Break
through
s) 1. .6 .4 .3 .2 .1 0
1962
and
1963 $10.336 4.590 2.459 1.464 0.980 0.583 0.260 0.000
1964
and 1. .2 0
1965 5.410 4.590 .820 0.000
1966
and .5 0
1967 2.295 2.295 0.000
For Am
(From
Mining
Bench) 1. .7 .4 .2 .1 0
1962
and
1963 4.921 2.290 1.429 0.730 0.326 0.146 0.000
1964
and 1. .4 .1 0
1965 3.291 2.290 0.818 0.183 0.000
1966
and .7 .2 0
1967 1.914 1.603 0.311 0.000
For As
(From
Downslo
pe) 1. .8 .6 .5 .3 .1 .1 .1

1962
and
1963 13.274 4.590 3.279 2.195 1.634 0.875 0.260 0.233 0.208
1964
through 1. .7 .5 .2 .1 .1 0
1967 10.494 4.590 2.869 1.830 0.653 0.292 0.260 0.000

156 SOURCES: The total costs imposed upon society in 1960 from acid mine water from the Appalachian Region was stated to be $9,570,000 by the U.S. Public Health Service, Water Pollution Control and Abatement, Hearings before a Sub-Committee of the Committee on Government Operations, House of Representatives, 88th Congress, 1st session (1964). Twenty-five percent of such damage comes from surface mining in Appalachia ($2 ,392,500) and Eastern Kentucky contained 6.976 percent of such mining in this region. In 1960 there were the equivalent of 14,556 acres newly surface mined in Eastern Kentucky. This equals $1 1.466 per disturbed acre (data for 1960 and 1961 not shown above). It is estimated that 2/5 of acid run-off water originates from the coal face and auger holes, 2/5 from the downslope, and 1/5 from the mining bench. The values of the coefficients, time spans, and proportions were determined in consultation with personnel of the Kentucky Reclamation Division (Kentucky Department of Natural Resources), Kentucky Reclamation Association, Water Researces Center, (Indiana University), and members of the industry. acre disturbed was derived from data presented by the U.S. Public Health Service. n7 (The data are for 1960 and are utilized to determine the costs for each year during the 1960-1963 period - only the two years of 1962-1963 are shown in Table 2.)

{157} n7. Water Pollution Control and Abatement, Hearings Before a Subcomm. of the House Comm. on Government Operations, 88th Cong., 1st Sess. (1964). The annual damages from acid mine water from the Appalachian Region for 1960 was estimated to be $9 ,570,000 by this Government agency. This estimate includes damages to: domestic water supplies, industrial water supplies, steamboats and barges, power plants, river and harbor structures, and floating plant, all damages occurring in the smaller streams in Appalachia, and the loss of aesthetic values in the area. While this estimate is a projection of a survey made in 1940, Tybout, in An Economic Framework for Evaluation of Acid Mine Drainage, Water Quality and Recreation in Ohio, Proceedings, Second Annual Symposium on Water Resources Research 229 (1966), states that these damages are " . . . probably as great today," and further that, " . . . the overall magnitudes cannot have changed radically except for steamboats downward and probably for power plants upward. The suggestion on the basis of information now available is that the total magnitude of the problem remains similar now to what it was in 1940," id. at 232.

157 The cost of acid mine water damages per disturbed acre of surface mined land in eastern Kentucky is calculated as follows. Only 25 percent of acid mine water originates at the surface mining operations; the remaining 75 percent arises from underground mining. Data presented by the U.S. Department of Interior n8 indicate that approximately seven percent of the surface mining in Appalachia took place in eastern Kentucky in 1960. Considering the number of acres newly surface mined in that year, plus such acreage in the preceding ten years, it is estimated that the equivalent of 14,556 acres were newly surface mined in eastern Kentucky in 1960. The amount of damage from acid water drainage thus equals $11.466 per newly disturbed acre.

157 n8.U.S. Dep't of Interior, Study of Strip and Surface Mining in Appalachia 23-24 (1966).

157 This cost was incurred during each year of the 1962-1963 period when relatively little reclamation was accomplished. Two-fifths ($4 .59) of this per acre cost is considered to arise from Source Ac (coal face, auger holes, and breakthroughs of underground mines); one-fifth ($2.29) from Source Am (the mining bench); and two-fifths ($4 .59) from Source As (the downslope of the removed overburden).

157 1. Source Ac

157 During the 1962-1963 period the Kentucky reclamation law and regulations required coverage of the coal face and auger holes, and the sealing of breakthroughs. This work was not always accomplished, due to lax enforcement by the state agency.Nevertheless, partial coverage after mining, plus fallen

material from above the seam, are considered sufficient to have caused a decrease and final halt of the flow of acid water from this source over the following six years. This decrease is indicated in Table 2 by the decline in the values assigned to the coefficients over the six-year period (a0 through a5). In 1964-1965, the coverage of the coal seam and auger holes was extended to two feet above the seam. Enforcement of this requirement halted the flow of this acid water in the second year after mining. In 1966-1967, coverage of the coal seam was further heightened to four feet above the seam. In addition, a shortening of the time period between coal removal and the accomplishment of this reclamation requirement gave rise to relatively less pollution from this source during the period of mining. Thus, the coefficient a0 t is reduced to 0.5 when t is 1966 and 1967 (table 2).

{158} 2. Source Am

158 In the 1962-1963 period, little regrading of the mining bench was required, coverage of acid producing materials was not effectively enforced, and a minimum of revegetation was accomplished. Water pollution from this source is considered to have continued for an average of five years, but in declining amounts (Table 2). Normal leaching of the soil plus some natural re-seeding of vegetation from surrounding areas caused such a decline. Regrading of material [*] the mining bench in 1964-1965, plus additional revegetation and coverage of toxic materials reduced the flow of acid water from the mining bench. This reduction is reflected in the values of the coefficients assigned this origin.
A further reduction of water pollution originating at this source was accomplished in 1966-1967 by additional grading and revegetation. A shortening of the time span for the performance of reclamation is reflected in the decrease in the coefficient value for the period of mining, a0 t from 1.0 to 0.7 when t is 1966 and 1967.

158 3. Source As

158 The flow of acid water from the downslope continues for a longer time than from the above two areas. While natural leaching also takes place on the downslopes, some sliding of the material down the hillside exposes new material. The grading of some of this overburden across the mining bench reduced the pollution from this source commencing in 1964. Although additional grading and revegetation was required in 1966, no reduction of acid water flow occurred in this year. As a result of the bench-width restrictions imposed in 1966, mining firms merely stacked the overburden higher causing no net change in the amount of water pollution from this source (Table 2).

158 The total external costs arising from the three sources of acid run-off water from surface mining for the 1962-1967 period are shown in Table 3 together with other external costs. It is noted here, however, that the total of these costs decreased from about $96,000 in 1962 to about $7 5,000 in 1967, (or about 22 percent) although the number of acres disturbed by surface mining increased approximately 52 percent over the same period.

{159} B. Source S - Silt and Sediment Materials

159 Surface mining in the steeply-sloping terrain in eastern Kentucky causes severe erosion of the soil material removed throughout the course of the mining process. During periods of heavy rainfall this material flows from the mining site into streams and other bodies of water. The water-carrying capacity of these streams is decreased and the storage capacities of lakes and reservoirs are reduced. On the basis of the U.S. Forest Service experiment in eastern Kentucky, the U.S. Department of Interior estimates that approximately 400 tons

of soil per acre of newly disturbed overburden flow into streams and other bodies of water.This quantity compares to about one ton of material from the same area prior to disturbance by surface mining. n9

159 n9. Id.

159 The external cost imposed upon other parties or society in general from this silt and sediment material is calculated herein on the basis of the cost to remove such material from streams, lakes and reservoirs. A cost of $0 .07 per ton is used as an estimated average for the removal of this material. n10 The spoil bank settles over time and becomes relatively more stable. This process reduces the amount of material flowing from the disturbed area.In addition, this reduction is accelerated by grading of the mining bench and by revegetation of the disturbed area. (Space does not permit the inclusion of the data used to calculate the total external costs caused by silt and sediment material from mining operations; i.e., data such as that in Table 2 for acid mine run-off water.) 159 n10.During the first year, an estimated 400 tons of silt and sediment flow from each acre of mined bench and spoil bank combined. The downslope of the spoil bank contributes 300 tons and the mined bench 100 tons. The downslope comprises 1/3 and the mined bench 2/3 of each acre. For each acre mined, 3.6 acres are disturbed. For each 3.6 acres disturbed, there are 2 acres of mined bench and 1 acre of downslope. For each two acres of mined bench 300 tons of material flow, or 83.33 tons per acre disturbed. For each 1 acre of downslope 900 tons flow, or 250 tons per acre disturbed. The removal of silt and sediment material from streams, rivers, lakes, and reservoirs is estimated to cost an average of $0 .10 per cubic yard of material. This material weighs an average of 105 pounds per cubic foot, or 2,835 pounds per cubic yard. Cost of removal equals approximately $0.07 per ton.

159 The total annual cost imposed upon other parties by silt and sediment material, originating on the mining bench fell from about $37,000 to $26,000 between 1962 and 1967, although the number

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TABLE
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Total
Extern
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Costs
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1962-
1967

Sources of External Costs

Per
Acre Per
Total Distu Ton
Year Ac t Am t As t Sm t Ss t B t O t L t Cost rbed Mined
$ $
$ $ $ $ 164,69 $ 308,6 $ $
1962 34,770 16,554 44,654 37,115 8 $3,364 $3,000 4,450 05 91.74 0.048
173,36 326,7
1963 36,600 17,425 47,003 39,068 4 3,541 5,000 4,700 01 92.26 0.047
20 143,64 263,1
1964 ,125 12,243 39,038 34,451 4 2,790 6,000 4,900 91 70.75 0.035
172,18 315,3
1965 24,123 14,675 46,793 41,295 0 3,344 7 ,000 5,900 10 70.71 0.033
170,44 270,1
1966 10,130 8,448 46,321 22,617 2 3,311 3,000 5,850 19 61.20 0.028
197,00 311,7
1967 11,709 9,765 53,540 26,143 9 3,827 3,000 6,750 43 61.10 0.027
[See Table in Original]

160 SOURCES: Totals of each source of external costs are from data presented in the text. Annual tonnages for computation of cost per ton mined are from Annual Reports, Kentucky Department of Mines and Minerals, for period covered.
of acres disturbed increased about one-half. The annual external cost of the material flowing from the downslope, however, rose from about $165,000 to $1 97,000 during this six-year period. While some additional grading of the mining bench and revegetation were required starting in 1966, total bench-width restrictions induced mining firms to stack the overburden higher. The reclamation requirements imposed upon the surface mining firms were relatively more effective in reducing external costs due to the silt and sediment material

given off from the mining bench than from the downslope of the removed overburden. These costs are shown with other external charges in Table 3.

{161} C. Source B-Loss of Aesthetic Values

161 The U.S. Public Health Service included the loss of aesthetic values in its valuation of total losses from acid mine water. The external costs from the silt and sediment material in streams and bodies of water include the associated aesthetic values. These two costs have been considered above. The aesthetic values of the land surface lost during mining incurred by the land surface owner is considered below. However, it may be claimed that the general public also suffers a loss when the scenic values of the nation's countryside are destroyed.

161 The hills of eastern Kentucky are covered with a growth of trees and other vegetation which most people would consider beautiful. This beauty is disturbed and interrupted by the strips of bare earth and rock exposed by surface mining. The exposure is greater where more than one coal seam is mined along the contour of the hills. Here, the overburden from one mining shelf flows downward and contacts the area exposed by mining operations at the lower altitude. Comparatively larger areas are denuded of vegetation when the entire upper portions of hills are removed during the mining process.

161 It is reasonable to assume that the general public is somewhat affected by the environment, and therefore recognition should be made of the loss of aesthetic values caused by surface mining in eastern Kentucky. Such a recognition is considered appropriate, since the reclamation requirements have reduced this loss. This charge upon society, however, must be valued at a relatively low level. Eastern Kentucky is not thickly populated, and is comparatively isolated from the surrounding areas. A higher value would appropriately be assigned to aesthetics in thickly populated regions.

161 For the 1962-1963 period, the loss of aesthetic values at the mining site by the general public is assigned a value of $1 .00 per acre disturbed. This amount is considered to include the loss during the year of mining and all future years discounted at the rate of twelve percent. The regrading and comprehensive revegetation requirements of the mined areas were commenced in 1964. This action not only ensured that more of the mined areas would be revegetated, but also shortened the time span necessary for relatively more complete coverage. Therefore, the loss of aesthetic values at the mining site is valued at $0 .75 per disturbed acre for the 1964-1967 period. The annual totals of this external cost are combined with other external costs in Table 3 (Source B).

{162} D. Source O-Losses Incurred By Owners of the Land Surface Only

162 Eastern Kentucky mineral rights were sold in the late 1800's and early 1900's by the landowners when surface mining methods were unknown. The broad form deed was used for the transference of these rights, and conveys all the coal and,

162 . . . the privilege to use and operate the surface in any and every manner that may be deemed necessary or convenient for mining, and therefrom removing . . . and in the use of said land and surface thereof by the grantee shall be released from liability for damages. n11

162 The separation of the land surface and mineral rights does not occur in all states. For example, in Indiana and Illinois a landowner may lease to a mining firm the right to exploit the minerals, but this lease or sale does not separate the mineral rights in perpetuity from the surface rights. Incidences of personal hardship involving some surface mining also are unique to eastern Kentucky; some cases of personal distress have occurred solely as a result of these separate ownerships. Some situations involving personal hardships are recounted by Harry M. Caudill. n12 At the same time, it must be noted that not all eastern Kentucky land has separate owners of the mineral and surface rights.The annual proportion of total disturbed land represented by acreage with separate owners has varied from about one-fourth to one-half during this six-year period. 162 n11. U.S. Dep't of the Interior, Surface Mining and Our Environment 103 (1967).

162 n12. H. Caudill, Night Comes to the Cumberlands (1962). In addition, some protests by owners of the surface only were voiced in connection with the passage of the 1966 revisions in the Kentucky reclamation law. Although some of this dissent against surface mining was made in response to damage or the threat of damage to the surface owner's property, a share of these remonstrances was made on other grounds. The mountaineer of eastern Kentucky has for generations feared and distrusted the outsider. The surface mining firm is considered an intruder.

162 Approximately 97 percent of all acres surface mined during 1962-1967 was disturbed by mining firms which had leased this right from the minerals owner who received a royalty for each ton of coal extracted.If this owner also owned the surface rights, i.e., fee ownership, he also incurred the cost of any damage to the land surface - destruction of trees and loss of aesthetic values.Therefore, rational calculation by the owner would have included this cost in the royalty payments for which he contracted.

{163} However, when the land has separate owners of the minerals and surface rights, the coal royalty is paid only to the mineral rights owner. In addition, if other factors are equal - coal quality, type and depth of overburden, transport costs - the royalty is equal to that paid to an owner of the land in fee.Thus, in this latter case, the owner of the surface does not share in the coal royalty. It would therefore appear that this surface owner receives no compensation for any damages caused by surface mining.

163 Nevertheless, eastern Kentucky surface mining firms leasing mineral rights on land with separate ownerships do pay the surface owners an "access fee." This payment is approximately $0 .25 per linear foot of land as measured along the highwall of the contour mining site. The amount per ton of coal varies widely, of course, depending upon the width and thickness of the coal seam strip mined and whether the auger method is also employed. While the owner of the surface rights only is somewhat compensated for damages to the surface, he lacks the necessary bargaining power to receive any economic rent which may be due because of the location of his land. Nevertheless, this access fee payment is considered to fully cover the surface owner's costs of temporary loss of the land use and the decrease in aesthetic values.

163 At the same time, the surface owners have clearly had some imposed external costs caused by the removal of the overburden; for example, large rocks rolling down the hillsides. Such damages have been associated with the operations of a minority of the mining firms. Personnel of the Kentucky Reclamation Division indicate that no more than 10 or 12 situations involving such damages occurred in the two years prior to 1966, and only about one-third as many since the law's newest revision became effective.

163 In 1964 and 1965 the disturbed acres with separate ownerships totaled 3,461. Assuming 12 cases of property damage during these two years, one damaging instance occurred per 288 acres (or fraction thereof) of disturbed land with separate ownerships. Estimated damages are $1 ,000 per case. We may apply this ratio of loss cases to acres disturbed in the years prior to 1964. However, due to the authority of the Reclamation Division to prohibit mining in areas where possible damage may result from such operations, the ratio for 1966 and 1967 is changed to one loss of $1 ,000 per 864 acres (or fraction thereof). The annual totals of this external cost imposed upon these surface owners are indicated in Table 3 (Source O).

{164} E. Source L-Losses Caused by Landslides

164 The sudden movement of portions of the spoil bank down the hillside in the form of landslides causes several types of damage. Some of these costs are already included in the previously calculated external charges. For example,

the costs caused by acid water and silt and sediment materials include the additional amounts of such damages brought about by landslides. In addition, the loss of aesthetic values at the mining site - landslides increase the barren area and inhibit the growth of vegetation - and the costs imposed upon surface owners include estimated charges arising from landslides.

164 Landslides, however, impose other costs upon society. In addition to increasing the flow of silt material from the mining area, a landslide itself may block or disrupt the water flow in a stream; the sliding material may cover a public road or highway. A comparatively massive landslide damages several acres of land below the mining area. At the same time, we must recognize that some landslides cause relatively little damage.The sudden sliding of removed overburden down the hillside in an isolated, uninhabited region may merely mean that the material now covers an additional acre of comparatively valueless undergrowth and scrub timber.

164 The Kentucky Reclamation Division reported in December, 1967, that approximately 135 landslides had occurred over the previous 12-month period. n13 Discussions with personnel of the Division concerning the cost of damages caused by landslides revealed that such costs are among the more difficult costs to estimate. As noted above, the locations and size of landslides are diverse. The estimated cost of the damage from a landslide may vary from almost nil to several hundred dollars. However, utilizing the data reported by the Division, approximately one slide occurred per 38 acres of disturbed land; and further, we may reasonably estimate an average damage cost of $5 0 per slide. The annual estimated totals of this external cost are shown in Table 3 (Source L).

164 n13. Hearings on New Reclamation Regulations in Kentucky, held in Frankfort, Kentucky, on Dec. 7, 1967 (unpublished transcript).

164 F. Total External Costs

164 While the total external costs per acre disturbed decreased over this six-year period - from about $91.74 to $6 1.10 - the aggregate external charges for eastern Kentucky rose from about $308.605 to $3 11,743 (Table 3). The annual acreage disturbed by surface mining increased over this same period from 3,364 to 5,102 acres. Thus, an approximate 52 percent increase in annually disturbed acreage was associated with only about a one percent rise in the annual external costs arising from such mining. Relatively more comprehensive and effectively enforced land reclamation brought about this comparatively lower increase in aggregate external charges. n14

164 n14. Two limitations of this analysis must be recognized here. First, the external costs shown in this examination are those arising from bituminous coal surface mining only in castern Kentucky during the period surveyed.The external costs originating from the contour mining operations in adjacent

regions, for example, would be different due to dissimilar definitions of "acres disturbed" and to the relative extent of surface mining in these other areas. Similar mining operations would probably impose comparatively higher external costs upon society in a more densely populated region. Second, the amount of any external charge is not considered to be exact. While some of these charges are based on the best considerations and projections of professional personnel

and government agencies, these costs remain estimates - other appraisals are possible. Nevertheless, the relative magnitudes of the various external costs and internal expenses would not be substantially changed by other reasonable assessments of these charges.

{165} Although the total annual eastern Kentucky surface-mined tonnage rose from 6,390,826 to 11,352,004 tons, or about 78 percent, over this six-year period, the total external costs per-ton-mined decreased from about $0.048 to $0 .027 per ton, or about 44 percent, over the same period (Table 3). This decline in total external costs per ton of coal produced may be attributed to two factors. First, increased land reclamation requirements were instituted and enforced over this period; and second, the average number of tons mined per acre disturbed increased. The latter increase was due to a rise in the average thickness of the coal seams exploited by strip and auger mining methods in eastern Kentucky from 3.8 to 4.45 feet between 1962 and 1967. Therefore, even without changes in the extent of land reclamation, the external costs per-ton-mined decreased annually. But, the increases in the amount of land reclamation in the years of 1964 and 1966 accelerated this decline.

165 III

165 INTERNAL EXPENSES

165 Increases in the amount of land reclamation performed by the bituminous coal surface mining firms during 1962-1967 caused an increase in internal mining expenses. Such charges are divided into two components for the purpose of this survey, i.e., enforcement expenses and direct land reclamation expenses. The former category includes: state permit and acreage fees, court fines, performance bond fees, and other charges (land survey, map, and administrative expenses). None of these expenses contribute directly to land reclamation. The second category, direct land reclamation expenses, includes those expenses associated with earth movement, revegetation of the mined area, and the construction of drainage ditches.

{166} A. Enforcement Expenses

166 The total expenses to the mining firms to obtain a permit to surface

mine bituminous coal in eastern Kentucky are indicated in Table 4. The permit and acreage fees, and court fines for violations of regulations are paid directly to the Kentucky Reclamation Division for its use in enforcing the law and regulations.

TABLE 4

Total Enforcement Expenses of The Kentucky Reclamation Law and Regulations Associated With Eastern Kentucky Bituminous Coal Surface Mining Incurred by The Mining Firms; 1962-1967

Year	Permit Fees	Acreage Fees	Court Fines	Performance Bond Fees	Map, Land Survey and Other Expenses	Total	Total Average Expenses Per Disturbed Acre
1962	$4,830	$20,950		$2,556	$815	$29,151	$8.67
1963	4,140	22,245		2,580	690	29,655	8.37
1964	6,960	53,815	$3,450	4,255	3,480	71,960	19.34
1965	9,810	109,075	2,375	10,038	4,905	136,203	30.55
1966	14,080	110,350	2,400	14,170	8,750	149,750	33.93
1967	22,750	127,550	9,190	20,903	11,375	191,768	37.59

166 SOURCES: Kentucky Reclamation Division files and regulations, and estimates made in consultation with members of the industry.

166 NOTES: Cost of permits is average of $30 per permit for 1962 through June, 1966, and $5 0 thereafter.

166 Performance Bond Fee is $1 2.50 per $1 ,000 bond, per year, Map, Land Survey, and Other Costs computed at following rates: 1962-1963, $5. per permit; 1964-1965, $15. per permit; and 1966-1967, $2 5. per permit.

166 Performance bond fees are paid to private bonding companies. The applicable fee - $12.50 per $1 ,000 bond per year - is regulated by the State of Kentucky. The estimated average expenses incurred by the mining firms to survey the mining site, to prepare and submit the required map, and other administrative expenses associated with a permit application are based on information obtained from members of the industry and the Reclamation Division. While the permitted acreage increased by about one-half between 1962 and 1967, the 1967 average enforcement expense per acre to the firm was over four times this expense in 1962. This rise is attributed to an increase in the acreage fee over this six-year period - from $10 to $2 5 per acre - and to an increase in the required performance bond per permitted acre - from $100 to $200 (minimum bond of $2,000 is required per permit).

{167} B. Direct Land Reclamation Expenses

167 1. Regrading

167 During the 1962-1963 period relatively little regrading of the surface mined land was required and performed. Some earth movement was accomplished to cover the coal seam face and to bury toxic materials. However, a sizeable increase in the expenses of regrading, burying of toxic materials, and the construction of drainage ditches occurred in the 1964-1965 period. Additional coverage of the coal seam, plus the grading of some removed overburden back toward the highwall, caused an increase in both labor and machinery time. Since grading does not take place on the downslope of the removed overburden, all acres disturbed are not graded. For each 3.6 acres disturbed, only approximately two acres are actually graded. An estimated seven actual acres could be graded in eight hours during this 1964-1965 period at an average expense of $1 8 per hour for labor and machinery. However, the number of acres regraded in the 1966-67 period in eight hours was reduced from an average of seven to five actual acres. This decrease was due mainly to the requirement to cover the mining bench with at least four feet of material from the removed overburden. From 1962 to 1967 these expenses rose from an average of $2 per acre disturbed to $1 6 as shown in Figure 2.

167 Figure 2

167 Data Utilized to Compute Direct Land Reclamation Expenses Associated with Eastern Kentucky Bituminous Coal Surface Mining, 1962-1967.

167 Required Grading, Burying of Toxic Materials and Drainage Ditches.

167 Period

167 1962-1963 - $2.00 per acre disturbed.

167 1964-1965 - $1 1.43 per acre disturbed. (Required work on 7 actual acres completed in 8 hours, at $18, per hour, equals $2 0.56 per actual acre. Two actual acres graded, etc. per 3.6 disturbed acres).

167 1966-1967 - $1 6.00 per acre disturbed. (Required work on 5 actual acres completed in 8 hours, at $18. per hour, equals $2 8.80 per actual acre. Two actual acres graded, etc. per 3.6 disturbed acres).

167 Revegetation

167 1962-1963 - $15.00 per acre disturbed. ($1 8. per actual acre revegetated; three acres planted per 3.6 disturbed acres).

167 1964-1965 - $25.00 per acre disturbed. ($3 0. per actual acre revegetated; three acres planted per 3.6 disturbed acres).

167 1966-1967 - $30.83 per acre disturbed. ($3 7. per actual acre revegetated; three acres planted per 3.6 disturbed acres).

167 SOURCES: Estimates based on consultations with members of the industry, Kentucky Reclamation Division (Department of Natural Resources), and representatives of the Kentucky Reclamation Association which performs revegetation of mined areas.

{168} 2. Revegetation

168 The revegetation of surface mined land durign the 1962-1963 period involved an estimated expense of approximately $18 per acre planted. Since only three acres are planted per 3.6 acres disturbed, this involved an average

expense of $1 5 per acre disturbed.Increases in revegetation requirements - planting and survival standards - caused a rise in this external expense over the 1962-1967 period.

168 The total average internal expense to the mining firms to perform the required direct land reclamation rose from $17 in 1962 to about $4 6.83 in 1967 per disturbed acre. These figures are set out in Table 5. During this six-year period the primary cause of the increase in

*7*TABLES

*7*Total Internal Expenses of the Eastern Kentucky Bituminous Coal Surface Mining Firms Incurred in Performing Land Reclamation ; 1962-1967.

Land

Year	Enforcement Expense Per Acre Disturbed	Percent of Total	Reclamation Expense Per Acre Disturbed	Total Per Acre Disturbed	Eastern Kentucky Annual Total	Total Expenses Per Ton Mined
1962	$8.67	34	$17.00	$25.67	$86,354	$ 0.014
1963	8.37	33	17.00	25.37	89,835	0.013
1964	19.34	35	36.43	55.77	207,464	0.027
1965	30.55	46	36.43	66.98	298,664	0.031
1966	33.93	42	46.83	80.76	356,475	0.037
1967	37.59	45	46.83	84.42	430,711	0.038

168 SOURCES: Kentucky Department of Natural Resources, and members of the industry. Annual production from the Annual Reports, Kentucky Department of Mines and Minerals. land reclamation expense per disturbed acre was the 8-fold increase in grading expenses - from $2 to $1 6. Revegetation expenses per disturbed acre approximately doubled between 1962 and 1967 - from $15 to about $30.83 (Figure 2).

168 C. Total Internal Reclamation Expenses of the Mining Firms

168 The total average internal expenses (enforcement fees and direct land reclamation expenses) rose from about $25.67 to $8 4.42 per acre disturbed between 1962 and 1967 (Table 5). During the same six-year period enforcement expenses comprised an increasing proportion of total average expenses per acre disturbed; rising from 34 to 45 percent.The total average expense per ton mined increased approximately 171 percent - from $0.014 in 1962 to $0.038 in 1967.

{169} IV CONCLUSIONS

169 A. External Costs and Internal Expenses Compared

169 Although the additional constraints contained in the 1964 and 1966 revisions of the Kentucky land reclamation statute and in the enforcement agency's regulations caused significant reductions in the amount of external costs imposed upon society, these decreases in external diseconomies were achieved only by larger internal expense increases, as shown in Table 6.

*5*TABLE 6
*5*Summary of
Average Total
External Costs
and Internal
Expenses
Associated with
Eastern

Kentucky
Bituminous Coal
Surface Mining
and Land
Reclamation;
Average Cost
Per Acre
Disturbed and
Per Ton Mined;
1962-1967.
*5*EXTERNAL
COSTS

Period	Average Total Per Acre Disturbed	Average Change From Previous Periods	Average Total Per Ton Mined	Average Change From Previous Period
1962-63	$92		$0.047	
1964-65	71	- $21	0.034	- $0.013
1966-67	61	- 10	0.028	- 0.006
TOTAL INTERNAL EXPENSES				
1962-63	26		0.013	
1964-65	62	+ 36	0.029	+ 0.016
1966-67	83	+ 21	0.037	+ 0.008
ENFORCEMENT EXPENSES ONLY				
1962-63	9		0.004	
1964-65	25	+ 16	0.012	+ 0.008
1966-67	36	+ 11	0.016	+ 0.004

169 SOURCES: Summary of data appearing in other tables and in the text.

169 NOTE: All per acre costs rounded to the nearest dollar.

169 The external costs were reduced during 1964-1965 (compared to the 1962-1963 period) $2 1 per acre disturbed; however, the mining firms' average internal expense of land reclamation rose $3 6 in the same period. Similarly, a further average decrease of $1 0 per disturbed acre was achieved in the 1966-1967 period; this decline, however, added an average of $2 1 per disturbed acre to the firms' internal expenses.On a per-ton-mined basis, much the same relationship exists between the reduction of external costs and the increases of internal expenses. The latter exceeds the former charges.

169 The shares of the increases in total internal expenses represented by the rises in average enforcement expenses per disturbed acre are also indicated in Table 6. In the 1964-1965 period, for example, enforcement expenses comprised $16 of the total $3 6 rise of internal expenses. Without the

enforcement expenses, the $2 1 decline in average external costs per acre disturbed would be associated with an increase of only $2 0 of internal expenses. Similarly, in the 1966-1967 period, without the $1 1 increase in average enforcement expenses per acre disturbed, the average $1 0 drop in external charges would be associated with an average $10 rise in internal expenses.

{170} The amount of reduction in external costs, per acre disturbed, per dollar of increase in internal expenses during 1964-1965 amounted to only $0.583 and $0 .476 in 1966-1967. Such a reduction, per ton mined, per one cent of increase in internal expenses, amounted to $0.0081 in 1964-1965 and to $0 .0075 in 1966-1967. Therefore, additional internal expenses caused by the increases in reclamation requirements in eastern Kentucky have reduced external costs, but at a declining rate. n15

170 n15. These conclusions may be reversed, of course, if one assigns higher values to the loss of aesthetic values. The assigned values are 1962-63: $1; and 1964-67: $0 .75 per disturbed acre.Suppose, however, that the loss of aesthetic values per disturbed acre were designated as follows: 1962-63: $37; 1964-65: $2 1; and for 1966-67: $9. In this case, the average total of all costs per disturbed acre would increase to $128 for 1962-63; $91 for 1964-65; and $69 for 1966-67. With these valuations a $3 7 decrease in external diseconomies would be associated with a $3 6 increase in internal expenses between the 1962-63 and the 1964-65 periods. Similarly, a decrease of $22 would be associated with an increase of such expenses of $21 1 between the 1964-65 and the 1966-67 periods. In like manner, the conclusions on a per-ton-mined basis would also be reversed with these higher valuations of aesthetic losses. Such increases, however, also involve the assumptions that the loss of aesthetic values in the 1962-63 period increase from approximately one to 29 percent of the total of all social costs per disturbed acre; in the 1964-65 period an increase from about one to 23 percent; and in the 1966-67 period from about one to 13 percent. However, these proportions and dollar quantities which would be required to reverse the conclusions are deemed to be unrealistic in the present case of eastern Kentucky.

170 While only the approximate amount of the increases of internal expenses represented by actual land reclamation costs (without enforcement charges) contributed to the associated decreases in external costs, eastern Kentucky surface mining firms could not be expected to perform the land reclamation without compulsions. Therefore, the expenses of enforcement cannot be avoided. n16 However, if the mining forms would have voluntarily performed the land reclamation, each dollar of the increase in internal expenses would have reduced external costs by approximately one dollar (per acre disturbed). This result, of course, raises the question of the desirability of requiring additional land reclamation. Except as recommended in the following section, a solution for this dilemma will not be suggested here.

170 n16. We may assume, however, that not all enforcement expenses are utilized for this purpose. The Kentucky Reclamation Division expends some funds for research connected with eastern Kentucky surface mining. Such research includes experiments concerning the growth and survival of various species of

trees and other vegetative cover in different types of soil. Thus, perhaps a small share of the firms' internal expense increases should be considered research and development expenses instead of land reclamation expenses.

{171} RECOMMENDATIONS

171 A. The State of Kentucky

171 Since the 1964 and 1966 revisions of the Kentucky bituminous coal surface mining reclamation law and regulations have caused greater increases in the mining firms' internal expensee than the decreases in external costs imposed upon society, the Kentucky General Assembly should carefully evaluate the present as well as any proposed additional land reclamation requirements applicable to such mining.

171 The Kentucky General Assembly might well turn its attention to other sources of external costs imposed upon society. For example, approximately 75 percent of the total acid water pollution originates from underground mining operations. Silt and sediment materials also flow from roads leading to these mines. Extensive erosion of the hillsides takes place where trees have been harvested. Legislation directed to reduce the external diseconomies originating from these sources could properly be considered.

171 B. Other Government Bodies

171 The experience of the State of Kentucky not only in enacting but enforcing more comprehensive surface-mined land reclamation requirements may influence the actions of other government bodies. Indeed, this may have already occurred. For example, such a law first became effective in late 1967 in the State of Tennessee. The existing statute in the State of Indiana was revised the same year. In addition, the U.S. Senate Interior Committee held hearings in June, 1968, on a proposed Federal land reclamation law. We may ask, however, whether the actions of the State of Kentucky should be followed.

171 But to evaluate the Kentucky experience, several guidelines are required for the particular actions to be followed by a government body in connection with the enactment of land reclamation provisions. Such actions should be based upon:

171 1. Recognition of the existence of external costs arising from the surface mining process.

171 2. Measurement of external costs.

171 3. Formulation of recommended procedures and regulations to internalize such costs within the industry, including estimation of necessary internal expenses.

{172} 4. Revision of recommended land reclamation requirements if internal expense increases exceed external cost reductions.

172 5. Institution of land reclamation requirements.

172 6. Measurement and comparison of actual cost increases and decreases after a trial period.

172 7. Further revisions of the land reclamation requirements.

172 The record of the Kentucky experience indicates that four of these seven items were considered; specifically,

172 1. Recognition by the State of certain external costs arising from surface mining was first made in 1954 when the original land reclamation statute was enacted.

172 3. Following the enactment of the original statute, the State formulated some procedures and regulations to require land reclamation following the surface mining of bituminous coal. Estimates of the internal expenses to perform the land reclamation were made upon the occasion of each revision of the state law. The projections by the Kentucky Reclamation Commission differed, however, from such industry estimates. For example, in 1964 the former projected costs of 5 to 10 cents per ton mined; the latter estimated costs of 60 to 90 cents per ton. (As shown herein the average expense was close to 3 cents per ton.)

172 5. If we equate the institution of land reclamation provisions with effective enforcement of such requirements, the State of Kentucky commenced the former in 1964.

172 7. Revisions of the land reclamation requirements were made almost every two years after the enactment of the original 1954 statute. The more significant revisions were made by the Kentucky General Assembly in 1964 and

1966.

172 The other three steps, numbers 2, 4, and 6 concern the measurement and comparison of costs - specifically - the need to calcuate internal expense increases and external cost decreases. These computations and their comparisons were not accomplished.

172 Requirements to reclaim the land after the surface mining of bituminous coal are applied to all surface mining operations. While the expenses to perform the reclamation are similar for all firms, n17 the reductions of external charges upon society vary from area to area. n18 For example, the external costs arising from any given mining operation are higher in the relatively more densely populated areas. Acid mine water and silt and sediment material, for example, cause higher external costs in areas containing roads, bridges and bodies of water than in relatively isolated localities. Thus, while the inerease in internal expenses per acre disturbed are almost uniform, the reductions in external costs will vary according to the location of the surface mining operations. These results might have been different if another approach had been used by the State.

172 n17. Differences exist, however, on a per-ton-mined basis due to varying coal seam thicknesses.

172 n18.That is, from area to area in eastern Kentucky. Different reclamation provisions do exist for such mining operations in western Kentucky where the contour method of mining is not used.

{173} Deviations from the preseribed land reclamation provisions are allowed in some cases in eastern Kentucky, but only when such exceptions cause higher

rather than lower external costs. For example, if the acidity of the removed overburden is so high that vegetation cannot survive, the mining operator may be allowed to revegetate equal acreage of other unreclaimed mining sites. Thus, for any site with this high acidity in a given population density, an area causing relatively lower external costs may be substituted for one causing comparatively higher costs.

173 A higher total reduction in external charges may be achieved if the reclamation provisions were viewed as minimum rather than maximum standards. Selective deviations in the extent of required reclamation would then be made toward more instead of less external cost reductions.

173 A government body administering a land reclamation law should include all seven of the aforementioned steps in its administrative procedures. This

inclusion will insure that recommended or instituted changes in surface mined land reclamation provisions are first assessed and compared with estimated and actual external cost reductions.

174 [From the Arizona Republic, Mar. 21, 1971]

SELECTED READINGS

ECONOMICS

STRIP MINING AND BLACK MESA

174 A lasting impression that emerges from today's article about the Black Mesa mining operation, elsewhere in today's Republic, is the precautions Peabody Coal Co. officials are taking.

174 For example, the article says, "It might be said that the archeologists are running the mine." For early in negotiations with the Navajo and Hopi tribal councils, the company agreed to preserve Black Mesa's rich archeological heritage. It agreed to restore and reseed the land after it has stripped away the coal. Its agronomist and reclamation advisers are on guard to see that the land is not simply used and abandoned.

174 Anyone who is familiar with strip mining operations elsewhere knows that concern for the land has been largely nonexistent. The coal fields are gouged with deep scars, huge soil banks add to the defacement, the remaining arid and acidic soil won't sustain vegetation, and nearby streams are often contaminated by sediment and acids drained from the exposed coal beds.

174 No wonder then that, even at a time when the nation's power plants require the cheap coal that only strip mining can provide, a West Virginia congressman recently proposed federal legislation to ban strip mining entirely.

174 Obviously, that is not a realistic solution - not when America's energy demands are rising, and when strip mining tonnage, presently about 40 percent of total coal output, is rising. For strip mining is not only twice as productive per man day as underground mining, meaning that it holds down the cost of electric power, but it is also considerably safer.

174 What is needed is legislation similar to that President Nixon requested of Congress, the establishment of federal standards for states that refuse within the next two years to set standards for reclamation (usually grading and replanting) of abandoned strip mines.

174 It goes without saying that this added cost will be passed on to coal consumers. But it also bears repeating that the fight to preserve and enhance

the environment, which opinion polls put at or near the top of every list of public concerns, requires more than merely a rhetorical commitment. It is going to require a financial commitment as well.

174 What Peabody has promised to do at Black Mesa far exceeds the proposed federal standards. And there is every reason to believe that the company is sincere - both because it has restored and reseeded in its Colorado coal fields, and because it has given repeated public assurances that it respects the Indian lands from which it will mine coal during the next 35 years.

174 As today's story points out, the Navajos and Hopis will receive $1 00 million in royalties during the lease period if the two power plants operate at the expected 85 percent capacity. That is a tremendous amount of money, particularly for tribes that have suffered from economic privation throughout their history.

174 Nevertheless, it would be hardly worth it if the Black Mesa mining operation left the tribes with slag heaps that defaced the land and rendered it useless for hundreds of years. That is why the environmental guarantees given by Peabody are every bit as important as the royalties the tribes will collect for the coal mined from their land.

174 [From the Arizona Republic, Mar. 21, 1971]

174 COAL IS BRINGING PROSPERITY TO BLACK MESA - SALARIES, ROYALTIES FOR INDIANS WILL CONTINUE FOR MANY YEARS

174 (By John J. Harrigan)

174 BLACK MESA. - Leo Frank, a young Navajo from Lukachukai, is a contradiction both as an Indian and by job description.

174 As a typical Navajo male, he should be earning less than $3 ,000 a year, but his pay is well in excess of $10,000.

174 His job title at Peabody Coal Company's Mine No. 1 is "oiler" but he is never seen with an oil can. The term is a throwback to the days of more primitive diesel equipment that required constant oiling.

174 He is mechanically responsible for a self-lubricating, $2 .5 million, gargantuan dragline boasting 180 feet of boom and a scoop that will remove 35 yards of dirt, about 50 tons, in a single bite. He is more mechanic, welder and

operator trainee than oiler.

{175} No one is probably more aware than he of the unpleasant fact of life that you cannot efficiently move 13 million tons of coal a year from depths of 55 to 110 feet without bothering some of the land, or overburden, above it. But you won't hear him or any of his fellow 66 Indians and 16 companion caucasian workers complaining.

175 There is little doubt, he would acknowledge, that coal mining has begun in earnest on Black Mesa. Deep black canyons surrounded by mountains of overburden on this year's 525-acre mining plot attest to it. And mining will move forward at the rate of about 400 acres a year, with the previous 400 acres being continuously replanted as it goes along.

175 Ecologists worried about whether Peabody Coal Company's intentions with Mother Earth are honorable will just have to wait and see. It's too early to tell.

175 The first load of coal was hauled April 25, 1970 - by trucker Leroy Arnold who said he drove like crazy to get it to the nearby crushing plant.

175 Ecologists and Navajos like Frank who have lived near here all their lives have the assurances of Peabody that the mining company has a full-time agronomist and the support of a half dozen other agencies to handle reclamation.

175 The company reassures in its official brochures that it will stick with its agreement with the Hopi and Navajo tribes to return Black Mesa "to as good a condition as received, except for ordinary wear, tear and depletion incident to mining operations."

175 Foremen, superintendents and employees in conversation, however, claim that the land will be better than when they started. Five deep wells, more than 3,000 feet, will be turned over to the Indians. Small lakes and ponds are expected to fill pits engineered with gentle slopes to allow cattle to drink safely from them.

175 Thirteen different grass varieties are being tested to find the best possible replacements for the present, overgrazed stands. The company also promises replanting of other landscaping to replace the pinyon and juniper now being bulldozed.

175 A 35-year coal mining lease here covers 65,000 acres, or an area roughly 12 by 16 miles, on land designated as Navajo-Hopi joint use area by presidential order of 1882. Of the 64,858 acres in the lease, only 14,000 have coal.

175 Present mining appears minimal from the air but massive from the ground.It represents a mere toe-in-the-door. Mine No. 1 will strip 24.5 million tons of highgrade coal over a five-year period for the Mojave generating plant near Bullhead City.

175 Peabody reduces the coal to chunks two inches and smaller. Conveyor belts transport it to nearby Black Mesa Pipeline, Inc, It is then pulverized, mixed with water and pumped at 4 miles per hour through a 275-mile pipeline to the Mojave plant under 800 pounds per square inch of pressure.

175 A second mine will open soon on the north end of the Mesa to provide coal for the Navajo generating plant at Page. Work will begin in a month on a railroad to transport it from here to Page.

175 Eventually the mines will produce 13 million tons of coal a year, eight for Navajo and five for Mojave.

175 Some of the Indians who have lived all their lives on these rolling, grass-covered hills are alarmed at the destruction, however, temporary.Most are the Chee and Yazzie descendants of a single family - Manymules. Others have accepted the reality and are benefiting from it.

175 Of the 78 Navajo families within the lease area, 53 have their homes over coal deposits. They will be temporarily relocated at the company's

expense.

175 They are well remunerated for their trouble, sometimes in more ways than one. The company in one case is not only paying a father for moving from his ancestral hogan but has hired three of his sons. They bring home combined incomes of more than $3,000 a month.

175 Stan Begay, one of Peabody's best Caterpillar operators, is one of the company's highest paid employees, often earning more than $1, ,200 a month. His brother, Wally, drives a company supply truck. They both grew up on the mesa they are now helping to dissect.

175 While reconstruction of the landscape and its possible success is still a question mark, the company has recognized the mesa's rich archeological heritage. It is sponsoring research by archeological teams at Prescott College. It provides summer mobile home quarters for student archeologists and often assists them by bulldozing large earth masses.

175 It might be said that the archeologists are running the mine. No strip mining will be done where major archeological finds have been located. So far, they have located 138 sites, of which 29 have been considered valuable enough to excavate. Ruins date back to a Pueblo people, the Kayenta Anasazi Indians, who farmed there between 600 A.D. and 1200 A.D.

{176} Aside from cultural pluses, the mine will be a boon to Indians and the tribes for years. The tribes will receive $1 00 million in royalties during the 35-year anticipated lease period if the two power plants operate at an expected 85 per cent capacity. The $3 .25 million-a-year royalties are based on a 25-cents-a-ton commission, "a higher royalty than had ever been negotiated for coal developed on Indian or public lands," Peabody said.

176 Some Indians - usually off in far-away Window Rock or Chinle - have complained that the 25-cent-a-ton commission was too small. They see traders selling back their coal at $3 a hundred pounds to them.

176 But local Indians here enjoy another fringe benefit - free coal. The company doesn't advertise it. It neither encourages nor discourages local Indians from loading up their pickup trucks and driving away.

176 Company officials report they seldom see the same pickup trucks twice - a testimonial to the high bituminous thermal unit rating of the anthracite. It is rated at 11,000 BTU per pound, with an ash content of 8 per cent - which will be the generating plants' filtering problem - and a sulfur content of 0.5 per cent, which is considered low.

176 Apparently one pickup load of the 11,000 BTU fuel will last one family a year or more.

176 Almost all of the workers at Peabody earn more than $1 0,000 a year, including laborers. It is not uncommon for an Indian with no more than a sixth grade education to walk home with a paycheck of more than $1 ,000 for a two-week pay period with some overtime. Understandably, there is a backlog of some 300 applications from Indians and non-Indians alike for jobs.

176 Eventually, the plant will hire 250 with about 75 percent of them Indians. Potential employees must be qualified, either by experience or by trainability. The company has been unable to locate qualified Indian electricians and diesel mechanics.

176 The highly skilled jobs mean big checks and big checks cause their own problems: Local traders don't have the financial resources to cash them.

176 Loren Crank a Navajo employee here sent out a recent letter to the editor that insisted, "The opportunity is here for the people who would just open their eyes and start a business of their own, such as banks, laundromats, grocery stores, good garages, trailer and car sales, theater, etc. (in nearby Kayenta) . . .

176 "I've heard so much of sheep, cattle and land.We had these since the beginning of time but so far I haven't seen anyone become self-supporting with it except anglos off the reservation, but they have them in large quantities, not just two or three hundred sheep, cows, but thousands . . . "

176 [From Mining Congress Journal, March 1971]

176 EFFECT OF WILDERNESS POLICY ON EXPLORATION ACTIVITIES - AN INDUSTRY
VIEWPOINT

176 (By J. H. La Grange, Land and PR Coordinator Bear Creek Mining Co.)

176 President Johnson signed the Wilderness Act at a special ceremony in the White House rose garden on September 3, 1964, bringing to a successful conclusion one of the nation's longest and most controversial battles. After more than 8 years of study, public hearings, debates, and controversy, the Wilderness Bill became the law of the land.

176 The congressional mandate is concise. Wilderness areas of the National Wilderness Preservation System shall be administered for the use and enjoyment of the American people. The wilderness character of these areas will be left unimpaired for future use and enjoyment as wilderness. Thus, the Wilderness Act provides a statutory base for preserving the remainder of the American wilderness as we know it today. These areas lie within our national forests, national parks and monuments, and the national wildlife refuges and ranges.

176 Fifty-four of the existing Wilderness, Wild and Canoe areas have been placed in the National Wilderness Preservation System established by the Act. Thirty-four Primitive areas of the national forests are to be included in the System during the 10-year period following the Act. Such inclusions are to follow a series of public hearings and reviews by the Secretary of Agriculture. During this 10-year period, roadless portions of over 70 national parks, national monuments, wildlife refuges, and wildlife ranges are to be reviewed by the Secretary of the Interior for possible inclusion in the Wilderness System.

{177} 40 TO 50 MILLION ACRES SUBJECT TO REVIEW

177 The Act set a schedule under which recommendations for one-third of these areas were to have been presented to Congress by the President within 3

years. Two-thirds are subject to his recommendations for inclusion under the Act within 7 years - the remaining areas by the end of the tenth year. All

together, this procedure can apply to 40 to 50 million acres of wilderness lands which are subject to review. These lie within preservation areas, units of the national park system and the wildlife ranges and refuges. By comparison, the total area of the national forests administered by the Forest Service is less than 190 million acres. Units of so-called "de facto" wilderness may also be included in the Wilderness System under the provisions of the Act. Such units could add still more acreage. A "de facto" wilderness, by popular definition, is a roadless area of wilderness quality not yet designated as Primitive or Wilderness. The Lincoln Back Country in Montana and the White Cloud mountains area in Idaho are examples of "de facto" wilderness.

177 INFORMATION GATHERING PERMITTED IN WILDERNESS

177 The Act permits prospecting and gathering of information on minerals in the established wilderness. Such activities must be conducted in a manner " compatible with the preservation of the wilderness environment." The Secretary of the Interior is directed by the act to develop and conduct recurring surveys of areas proposed for inclusion in the Wilderness System. The results are to be available and submitted to Congress. There is nothing in the Act to indicate that recommendations to delete areas from Wilderness classification due to mineral character will be followed.

177 The Act states that surveys will be conducted in a manner "c consistent with the concept of wilderness preservation." The Act and the applying Rules and Regulations specifically prohibit temporary or permanent roads, aircraft landing strips and heliports or helispots. Use of motor vehicles, motorized equipment, motor boats, or other forms of mechanical transport is prohibited. You may not land aircraft or drop materials, supplies or persons from aircraft. Structures or installations and cutting trees for non-wilderness purposes is prohibited. There is an exception where these purposes existed prior to the designation of the National Wilderness Preservation System. However, persons with v valid mining claims or other valid occupancies wholly within the Wilderness are permitted access. Access is limited to that "consistent with the preservation of the forest wilderness." Consider how you might build a road consistent with preservation. Now go a little further and consider the ramifications of the word "valid" with reference to an unpatented mining claim.

177 Permits may be issued for access. The permits prescribe routes of travel to and from the area surrounding claims or occupancies. They also prescribe the mode of travel and other conditions reasonably necessary to preserve the wilderness. Mining development or timber cutting is permitted on a

valid claim. However, there are certain specifications requiring that the Forest Service be furnished with operating plans before a permit is issued. An operating plan must be submitted and approved before a permit will be issued to construct an access road. There is a provision whereby special request may be made for use of motorized equipment and to land aircraft during prospecting. However, in practice, such permission is not normally granted except on a valid claim.

177 LOCATIONS BANNED AFTER 1983

177 Claims may be located under the mining laws or the mineral leasing laws until December 31, 1983. Mining rights acquired prior to that date will be honored. Prospecting other than on valid claims, and the location of claims, is permanently banned thereafter. Exploration work done on the claims is subject

to restoration as nearly as practicable to the original surface contour upon completion of the work.

177 To understand the effect of Wilderness Act policy on exploration activities, we must determine what that policy is. A broad-scope analysis is necessary to identify all of the elements which determine this policy with regard to mining.

177 There are four primary sources of Wilderness Act policy having an impact on mining. The first source is Congressional intent as expressed in the Act itself. The second source is the Department of Agriculture, particularly the Forest Service. Those agencies are responsible for the management of the wilderness areas and the implementation of the Act. Rules and regulations were promulgated pursuant to the Act by the Secretary of Agriculture. In addition to directives contained in the rules and regulations, policy is being continually determined and altered by the ongoing Forest Service administrative experience.The third major source of wilderness policy is public opinion as expressed by the various, more or less powerful, wilderness recreation and preservation interest groups such as the Sierra Club. Such organizations are constantly applying pressure on the Forest Service to take actions and establish policies which hinder the activities of mining companies.These organizations are dedicated to a single use principle of absolute preservation of the pristine forest untrammeled by the works of man. The fourth source is, of course, the mining interests who seek Forest Service action or cooperation with respect to lands under Forest Service jurisdiction.

{178} CONGRESS RECOGNIZED MINING AS PRIORITY LAND USE

178 The policy of Congress in enacting the Wilderness Act is to, in effect,

recognize mining as a priority use of wilderness lands. There are, of course, very important limitations as mentioned previously. Development and operation of a mining property is obviously in conflict with the fundamental concept of the Wilderness Act - that is, preserving wilderness.Yet the Act allows mining development indefinitely with the limitation that new prospecting and claim location must cease after 1983. This is clear policy. Furthermore, it is a reasonable interpretation that the limitations on human activities are to protect the wilderness as much as possible. However, such limitations should not effectively prohibit mining.

178 The Forest Service, as the direct implementing agency of the Wilderness Act, is faced with a difficult task. How does one manage a program which attempts to provide for mutually exclusive uses of the same area? One or the other use must come out on the short end, and to date, it seems to be mining.

178 In addition to the restrictive rules and regulations established by the Secretary of Agriculture, another level of rules and policy making must be considered. In promulgating rules and regulations, the Secretary of Agriculture asked the Forest Service to prepare individual plans for the implementation of the Act in each of the 54 established wilderness areas. These plans were to include whatever special regulations or restrictions were deemed necessary due to local circumstances to protect the area involved. Consequently, before going into any wilderness area, the prospector or miner must determine what special rules he must comply with in addition to those contained in the Wilderness Act.

178 The policy of the Forest Service supervisor who administers rules and regulations under the Act is necessarily affected by interdepartmental directives and memos. He is further affected by general unwritten departmental policy, vocal special interest groups and even some personal prejudices. Lower echelon interpretation of the rules and regulations may vary widely from place to place.

178 USE PERMIT REQUIRED FOR PROSPECTING

178 Written permission in the form of a Special Use Permit is required for virtually every type of prospecting and exploration activity other than walking. Access theoretically may not be denied. In fact, it may be denied or prohibitively delayed for any number of reasons, including lack of discovery. Due to administrative slowness, negotiations for Use Permits usually require a lead time of from 3 to 6 months.

178 The problem of what constitutes a valid discovery is not within the scope of this discussion.It should be noted, however, that permission to use powered equipment and perform many modern exploration activities in Wilderness

areas is contingent upon the existence of a valid claim. The Forest Service has the option of disagreeing as to whether a discovery has actually been made.

178 The supervisor has the problem of satisfying many interests. He must satisfy his supervisors who are influenced by the Congress and special interests groups. He must satisfy the local populace with whom he must live and maintain good day-to-day relationships. He must fulfill the desires of the prospector. The supervisor's decisions must lie within the law, yet will almost always involve a compromise among all interested parties. It would appear the Forest Service will try to avoid blanket rulings from Washington headquarters. This is effected by making decisions and rulings on a local level as much as possible. This, of course, resolves itself into a policy of "play it by ear" for the prospector. He cannot expect any guarantees that he can explore in the most efficient manner at his command, nor can he be free from threats of administrative restraints that may be thrown over his operations.

{179} RESTRICTIONS WOULDN'T HAVE BOTHERED OLD-TIME PROSPECTOR

179 To comprehend the aggregate effect of these elements of Wilderness Act policy, one must understand the nature of modern minerals exploration. The various restrictive Wilderness Act rules and regulations would not have appreciably affected the old-time prospector with essentially unlimited time resources. He required only individual initiative, primitive means of transport, and no mechanized devices to prosecute his exploration program. The modern exploration effort, by contrast, requires a large amount of capital and is extremely complex. It utilizes a variety of scientific devices to determine or predict the presence of mineralization. It employes as many labor-saving and time-saving mechanical devices as possible.

179 An exploration program often commences with a time-consuming evaluation of large areas. This is to determine the location of zones containing anomalous amounts of valuable minerals. These mineralized zones may have very little surface expression and may outcrop only sporadically. Profitably locating the zones themselves and exploration targets within these zones requires a very efficient, highly mechanized and extremely flexible program. These mineralized areas or targets may be located by recognizing surface or subsurface

alteration products. Certain trace elements normally occur near or within known ore bodies. Anomalous electrical conditions of both a regional and a very local nature or an unusual concentration of various elements in soil or water are also indications of mineralized areas.

179 One of the most efficient and expeditious methods of regional sampling and mapping in roadless or remote areas is by helicopter drop of men and

equipment. Drop locations are decided as a given exploration program progresses and utilizes information and ideas developed from the program itself. Long-term preplanning as to drop points and sampling points is practically impossible. A high degree of unfettered mobility is required during this stage; aircraft and powered surface vehicles are essential.

179 Once a target is located, further geochemical and geophysical methods, as well as detailed surface mapping, are employed to decrease its size. This makes the prospect amenable to evaluation as to tonnage, continuity and probable extraction costs based on present and projected economic conditions. The information for many such evaluations is normally obtained from diesel or gasoline-powered drilling equipment or a variety of powered devices for tunnel driving or shaft sinking. Generators are usually necessary to provide an electrical power source for geophysical equipment or campsites.

179 LIMITATIONS AFFECT EFFICIENCY OF PERFORMANCE

179 Several years ago, an exploration project in the Absaroka Wilderness required some unusually time-consuming and complex planning. This was due to pressure on the local Forest Service by recreationists, resort owners and packers. A joint public announcement describing exploration plans was requested by the Forest Service. This is normally a serious breach of security because it invites competition to share the ideas and benefit of extensive and expensive reconnaissance. Stipulations in the prospecting permit required that helicopter flight operations to spot and service drill rigs be limited to hours between daybreak and 9 a.m. Flights were required to be at altitudes greater than 1000 ft, except when landing on claims. Off-claim landings were not permitted at all. Transport of drilling equipment to various locations on the claims was necessarily restricted to the hours of permitted use.

179 The purpose of these restrictions was to avoid scaring horses and disturbing the Wilderness solitude. Except for emergencies, five days notice was required for deviations in permitted flight patterns. No personnel could be transported in the aircraft. Such limitations certainly do not allow for efficient use of personnel and material.

179 OPPOSITION TO DEVELOPMENT USUALLY TO BE EXPECTED

179 Once it is apparent that a Wildenress prospect may be developed, some formidable opposition will usually arise. General public interest may be focused by preservation-oriented individuals or organizations dedicated to the prevention of wilderness development. Present concern for the environment and the popular public reaction of objecting to any kind of new industrial development serves to aggregate the situation. The general pattern of attack is to flood large-circulation newspapers and national periodicals with stories of the natural attributes of the area. How the area will be destroyed by mining is

usually described vididly. Support for such preservation programs is mustered from state and federal legislators and persons of national stature. This

support is enlisted through influential organization members and by letter writing campaigns. Attempts may be made to pass punitive laws or zoning regulations which are directed toward severely encumbering or prohibiting mine development.

179 Kennecott Copper Corp. has mining property under development in the Glacier Peak Wilderness area in Washington. Several years ago, it was awarded a great deal of uncomplimentary publicity both nationally and locally. This resulted from a drive by preservationists to establish a 1.5 million acre North Cascade National Park. Mining development was cited as a prime example of what could happen if the area was not preserved as a national park. Some of you may remember the "Open pit that could be seen from the Moon" as publicized in a full-page ad in the Wall Street Journal.

179 PROBLEMS OF EXPLORATION MANAGER ARE NUMEROUS

179 Think about some of the problems an exploration manager must consider before committing scarce company funds to exploration in a Wilderness area:

179 The Forest Service may contest the validity of unpatented claims based on lack of discovery.

179 The Forest Service may refuse a Special Use Permit or use of motorized equipment on the grounds that the proposed activities or the use of such equipments is not consistent with wilderness preservation or compatible with the wilderness environment. Where there are no clear grounds, a permit can be delayed by holding public hearings. This is to obtain expert and lay opinion as to the interests and effects of the permits. Very often some serious objection to granting the permit or some reason for further investigation and delay can be generated by such a hearing. Experience of American Smelting and Refining Co. in the White Cloud mountains in Idaho is an example.

179 If the Forest Service grants a Special Use Permit without a hearing, individuals or interested groups can call for reconsideration. Hearings will then be held on the grounds of an unconsidered interest or danger.

179 Local zoning can be asserted to prevent development where existing codes can be so interpreted, or new zoning can be established. Such zoning probably would not be upheld in court, but could result in time-consuming litigation.

179 Individuals or groups can take advantage of every opportunity afforded

by law to review, study and reconsider decisions of the controlling government agency. An example would be the delay encountered on building of the Trans Alaska pipeline.

179 If all else fails, individuals or groups may prosecute a Class Action Suit on behalf of all interested parties (Wilderness recreationists, etc.). Such action could temporarily or permanently enjoin road building or mining activity. Presumably, when the law does not grant an unqualified right to pursue the opposed activity, a court can issue such an injunction on a variety of temporary or permanent grounds.

179 The power of condemnation is always open to the federal government. It is entirely conceivable that the government would be willing to condemn a mineral property and pay its fair market value to prevent a mining operation.

179 It is an exploration manager's responsibility to minimize the commitment of exploration funds and to obtain maximum probability of success in locating an ore body. An integrated reconnaissance program involving men, aircraft and geofinancial or equipment contractors requires large sums of money. There are severe financial penalties for poor timing. When large development funds are committed, land control and unimpeded progress toward profitable production must be guaranteed. The specific rehabilitative and environmental control measures required need to be defined. Uncertainty in any of these matters greatly increases the already high risk of no return from exploration expenditures.

{181} LEGAL UNCERTAINTIES INCREASE RISKS

181 We in the mining industry have an obligation to maintain a healthy domestic mineral industry - an industry which can continue to supply a large portion of the raw materials so essential to our economy. This is becoming more essential than ever because of the growing tendency of foreign governments to impose difficulties in the way of U.S. companies in developing sources of minerals. The intent of Congress to continue mining rights is clearly expressed in the Wilderness Act. We should have the right to give Wilderness areas the exploration attention Congress allowed. However, we are finding it difficult to do so because of unpredictable risks occasioned by unduly restrictive regulations inconsistently administered. The risks are increased by legal uncertainties generated by the activities of special interest groups.

181 There are only 13 years remaining to exercise Congressional intent under the Wilderness Act. So far, we've let seven go by without much effort. Many of the situations I have described may very likely extend to all areas of federal lands in a short time. It's long past time for the mining industry to cooperate, organize and make a positive effort to cope with this serious

problem.

SELECTED READINGS

RECLAMATION.

{189} RESTORING SURFACE-MINED LAND

189 By the U.S. Department of Agriculture

189 Introduction

189 A power shovel as big as an office building bites into the earth, piling up row on row of rock and soil to get at a vein of coal . . . .

189 An auger with a 7-foot bit bores into a hillside, and coal works its way out like wood shavings . . . .

189 A floating barge dips its big chain-bucket into a streambed for a load of sand and gravel . . . .

189 An ore-laden train snakes its way out of a giant open pit . . . .

189 Through these and other operations man carries on the big activity of surface mining. He gets many minerals, fuels, and building materials that help our Nation grow and that provide jobs in rural America.

189 In the process, the land is changed - laid bare, rearranged into parallel ridges, or scooped out like a soupbowl. Properly treated and managed, it can be returned to safe and productive use, even become a greater asset to the community than it was before mining. Left alone, it may produce only stream-fouling sediment and acid and ugliness.

189 [See Illustration in Original]

{190}
TABLE 1. - Land disturbed by strip and surface mining in the United States, by commodity, Jan. 1, 1965 n1

[In thousands of acres]

Mineral	Strip mining Contour	Strip mining Area	Strip mining Total	Into hillside	Quarryopen pit below ground level	Dredge, hydraulic, and other	Total	Grand total methods n2
Coal n3	665	637	1,302					1,302

Sand and gravel	38	258	296	82	371	453	74	823
Stone	6	8	14	100	127	227		241
Gold		8	8	1	3	4	191	203
Clay	10	26	36	22	44	66		109
Phosphate	28	49	77	13	93	106		183
Iron	7	31	38	30	96	126		164
All other	11	12	23	59	81	140		163
Total	765	1,029	1,794	307	815	1,122	272	3,188

190 n1 Acreage by method of mining estimated from random sampling survey.

190 n2 Compiled from data supplied by U.S. Department of the Interior; from Soil Conservation Service, U.S. Department of Agriculture; and from estimates prepared by the field study group.

190 n3 Includes anthracite, bituminous, and lignite.

190 For many years the U.S. Department of Agriculture (USDA) has been helping private-land owners restore their surface-mined land as part of their regular programs of wise land use and conservation treatment. USDA also has done restoration work and research studies on the public land it administers. Its experience and skills range all the way from preplanning mining to prevent offsite damage to development of a mined area for highly intensive uses.

190 Through studies and experience and through participation in the 2-year National Surface Mine Study under Public Law 89-4, USDA has gathered a great deal of information about surface-minedland conservation progress and needs. In this report highlights of the data are given as well as ideas for future action, suggested by research and experience, that can speed restoration of the surface-mined land that is intermingled with farm, ranch, forest, and other land in rural and suburban America.

190 SURFACE-MINED LAND - BY STATES. - An estimated 3.2 million acres of land - some in every State - had been disturbed by surface mining by January 1, 1965 (tables 1, 2).

190 DISTANCE FROM POPULATION CENTERS. - Surface-mined-land conservation is a rural opportunity. More than four-fifths of the mined land surveyed is at least a mile from communities with a population of more than 200. More than half are more than 4 miles from town. And 40 percent of the mined land cannot now be seen from any U.S. highway or passenger railroad. Most areas were close enough to communities, though, for a family to reach for an afternoon recreation

outing. No urban growth was evident around two-thirds of them, which suggests that these areas are likely to continue in agricultural and related uses.

190 OWNERSHIP. - Ownership of the land and its minerals holds the key to use and conservation of these resources. Since most surface-mined land is privately owned, opportunity for improvement lies largely in local assistance programs of mutual interest and value to landowners and their neighbors - the kind of program already being carried on by the Nation's 3,000 soil and water conservation districts and by State forestry agencies with USDA help. Increased assistance through these going programs could do the job.And since the mining industry owns more than half of the surface-mined land, it has a challenge to restore its property to a useful state and to prevent offsite damages.

190 A survey of 693 surface-mine sites n1 in 1966 showed that many were scattered small acreages best treated as part of the total conservation management of the farm and other areas with which they are intermingled. Nearly 80 percent of the sites were in forest, farm, or grassland or reverting to forest at the time of survey. These same uses were being made of land adjacent to 86 percent of the sites. Less than 2 percent of the acreage had been set aside solely as outdoor recreation or wildlife areas; usually these are compatible with other uses of the land.

190 n1 Sites were selected at random from mined land throughout the Nation to represent the surface-mining situation. Of the total, 180 sites were mined for coal; 149 for sand and gravel; 100 stone; 49 clay; 49 iron; 48 gold; 40 phosphate; and 78 for eight other commodities.

{191}

TABLE 2. - Condition of surface-mined land, by State, Jan. 1, 1965
4[In thousands of acres]

State	Land needing treatment n1	Land not needing treatment n1	Total land disturbed n2
Alabama	83.0	50.9	133.9
Alaska	6.9	4.2	11.1
Arizona	4.7	27.7	32.4
Arkansas	16.6	5.8	22.4
California	107.9	66.1	174.0
Colorado	40.2	14.8	55.0
Connecticut	10.1	6.2	16.3
Delaware	3.5	2.2	5.7
Florida	143.5	45.3	188.8
Georgia	13.5	8.2	21.7
Hawaii n3			

Idaho	30.7	10.3	41.0
Illinois	88.7	54.4	143.1
Indiana	27.6	97.7	125.3
Iowa	35.5	8.9	44.4
Kansas	50.0	9.5	59.5
Kentucky	79.2	48.5	127.7
Louisiana	17.2	13.6	30.8
Maine	21.6	13.2	34.8
Maryland	18.1	7.1	25.2
Massachusetts	25.0	15.3	40.3
Michigan	26.6	10.3	36.9
Minnesota	71.5	43.9	115.4
Mississippi	23.7	5.9	29.6
Missouri	43.7	15.4	59.1
Montana	19.6	7.3	26.9
Nebraska	16.8	12.1	28.9
Nevada	20.4	12.5	32.9
New Hampshire	5.1	3.2	8.3
New Jersey	21.0	12.8	33.8
New Mexico	2.0	4.5	6.5
New York	50.2	7.5	57.7
North Carolina	22.8	14.0	36.8
North Dakota	22.9	14.0	36.9
Ohio	171.6	105.1	276.7
Oklahoma	22.2	5.2	27.4
Oregon	5.8	3.6	9.4
Pennsylvania	229.5	140.7	370.2
Rhode Island	2.2	1.4	3.6
South Carolina	19.3	13.4	32.7
South Dakota	25.3	8.9	34.2
Tennessee	62.5	38.4	100.9
Texas	136.4	29.9	166.3
Utah	3.4	2.1	5.5
Vermont	4.2	2.5	6.7
Virginia	37.7	23.1	60.8
Washington	5.5	3.3	8.8
West Virginia	111.4	84.1	195.5
Wisconsin	27.4	8.2	35.6
Wyoming	6.4	4.0	10.4
Total n4	2,040.6	1,147.2	3,187.8

191 n1 Compiled from data supplied by Soil Conservation Service, U.S. Department of Agriculture.

191 n2 Complied from data supplied by U.S. Department of the Interior; from Soil Conservation Service; and from study-group estimates.

191 n3 Less than 100 acres.

191 n4 Does not include 108,000 acres of National Forest land needing treatment.

191 [See Graph in Original]

{192} [See Graph in Original]

192 SURFACE-MINED LAND - BY COMMODITIES. - More than 50 minerals are produced by surface mining in the United States. About 95 percent of the acreage disturbed by 1965 was for seven commodities: Coal, about 40 percent; sand and gravel 25 percent; stone, gold, clay, phosphate, and iron 30 percent. On two-thirds of the areas surveyed, the mineral deposit being mined was over 9 feet thick. This means great value from an acre but difficulty in reshaping the land to its original contours. Grading enough to satisfy intended land use is more practical. Some thin deposits might better have been left unmined where restoration costs would be proportionately high.

192 AGE OF SURFACE MINES. - Of the 693 sites sampled in 1966, 10 were mined more than a century ago. But most spoil banks and other disturbances are less than 10 years old, indicating a rapid rise in surface-mining activity. The acreage mined has more than doubled in the last 20 years.

192 DURATION OF SURFACE MINING. - More than half of the sites sampled were quarries or pits that had been operated for more than 10 years. Only a third of the sites had been operated for less than 5 years.Most were active long enough to have a significant economic impact on the community, and usually other surface-mining operations began later within the same watershed or drainage area.

{193} [See Illustration in Original]

193 Characteristics and Physical Condition

193 Of the 3.2 million acres disturbed by surface mining, about a third needs no further treatment to prevent sediment or other damage to adjacent land and water. About 46 percent of these 1.1 million acres that need no treatment was stabilized by nature over a period of years; 51 percent was treated through efforts of the mining industry and individual landowners; and the rest was treated by government at some level.

193 On the other two-thirds, newness of the disturbed area, distance from natural seed sources, or other problems make establishment of protective plants slow or difficult. Steep or unstable slopes, acidity, or stoniness are problems in some areas. These are susceptible - in varying degrees - to erosion and may contribute sediment and other pollutants to streams that drain them.

193 Spoil banks

193 In surface-mining operations the layers of soil and rock above the mineral deposit are shoveled out and piled up in "spoil" banks. These banks are a mixture of soil, subsoil, and unweathered rock that is far from resembling a soil formed in nature. Their characteristics vary greatly among mines, and even within the same mine.Prediction of site suitability thus is best done with the help of professional soil scientists, agronomists, foresters, and other specialists.

193 TEXTURE. - Spoil texture influences the amount of moisture available for plant growth. In general, spoil composed largely of sand has good aeration but is apt to be droughty. Clay banks compact easily and crust over during dry periods. Loams and silty shales usually have enough fine material to hold moisture. On about 80 percent of the surface-mined land, spoil texture is adequate for growing adapted grasses and legumes for quick erosion control and to supplement tree or shrub

{194} [See Graph in Original] plantings. Rock content on about three-fourths of the banks, however, restricts the type of equipment that can be used in revegetation. On about one-fourth of the banks the spoil is suitable for farm crops.

194 ACIDITY. - Acid problems are associated largely with coal mining. They are caused when minerals left exposed to air and water react to form toxic or corrosive substances.

194 [See Graph in Original]

194 By itself, acidity does not directly influence plant growth. But it affects the availability of soil nutrients - dissolved minerals - and the

number of soil micro-organisms. Strongly acid soils may, however, dissolve enough elements to injure or destroy plants that absorb them.More than half of the sites have acid soils; 20 percent are acid enough to be a limiting factor in establishing plant cover; only 1 percent is so acid that plants will not grow. Acidity usually is reduced through weathering and leaching of the acid-forming materials.

194 SLOPES. - More than 2 million acres (about 75 percent) have been mined on areas with original slopes of less than 20 percent - in the small watershed projects with which USDA has been working most of the mined areas have slopes of less than 10 percent. Only about 8 percent of the mined areas were on hillsides with slopes of more than 40 percent.

194 Four-fifths of the affected areas were on side slopes, ridgetops, or isolated knobs from which storm-water flows need to be guided into defined stream channels - with grass waterways or chutes, for example. The other one-fifth were on valley floors close to rivers and subject to local flooding.

194 Climate

194 About four-fifths of the surface-mined land is in areas where rainfall and temperatures are adequate for plant growth. With adequate spoil conditions and proper preparation, plant establishment and growth should be possible. On the other one-fifth, plants grow slowly because of too little or too much moisture, high temperatures, or unfavorable evapotranspiration ratio. Here special treatments and plants are needed to offset poor ecological conditions.

194 Erosion

194 About 2 million acres have evidence of sheet erosion. Some erosion is inevitable on fresh spoil banks, as it is on any bare soil. How severe it is depends on steepness and length of slope, extent of freezing and thawing, amount and intensity of precipitation, and how water is concentrated on the spoil. Thus, the quicker a plant cover is established to protect against erosion the better.

194 Forty percent or 1.2 million acres have eroded enough to form rills and small gullies. On 12 percent or 400,000 acres, gullies more than a foot deep have formed; these seem to be associated with long slopes created by grading.

194 Sheet erosion is not a serious problem in either area stripping or dredging since most of the soil movement is between spoil banks and little leaves the mine area. Sheet erosion is more serious in contour stripping.

{195} Erosion danger is greatly increased at the point where storm water drains from a surface mine because of the concentrated force of water.

195 SLIDES. - On about 3,600 miles of slopes left by contour and area stripping (called outslopes), massive slides are a problem - especially where the subsoil is unstable.Slides may enter streams and even block channels. Their stabilization or removal would be costly and would involve geology, soils,

engineering, hydrology, and forestry skills. Slides of this size occur on about 10 percent of the total mileage of outslopes.

195 ACCESS ROADS. - Mining haul roads are responsible for much erosion, especially in mountain areas. About 1,650 miles of these roads have eroded so badly they need major repairs. Another 3,300 miles are moderately eroded.Access roads for most mines surveyed were under 7 miles in length, and many were of half a mile or less. Many would best be revegetated rather than kept as roads. The rest need careful management after hauling stops.

195 Plant cover

195 For newly mined land, the great need is to establish plant cover as quickly as possible. Adequate plant cover reduces erosion and siltation in almost all cases, but it takes time. There is no "instant cover." Examination of sites capable of supporting vegetation showed that 36 percent had plant cover of 40 percent or more. About 28 percent of the sites had less than 40 percent cover at the time but, in the judgment of the survey team, would develop adequate protective cover naturally in time. The other 36 percent of the sites will require seeding, planting, fertilizing, and other attention to develop adequate protective cover.

195 It was estimated that three-fourths of the vegetation had occurred naturally on ground with more than 10 percent plant cover, and one-fourth through the efforts of man. Variations in vegetation appear to be associated with climatic conditions, spoil characteristics, nearness to natural seed sources, and age of the spoil banks. Half of the banks are less than 10 years old.

195 Water quality and streamflow

195 Surface mining in some areas is a source of water pollution, mainly sediment and to a less extent acid. Of the sites surveyed, 56 percent showed no pollution; 23 percent showed some intermittent pollution; and 21 percent produced considerable pollution. The survey team estimated that about a third of the surface-mined land needing conservation treatment, or about 665,000 acres, needs some action to reduce offsite water pollution.

195 Of the streams receiving direct runoff from surface-mined sites, 31 percent of those examined contained noticeable amounts of mineral precipitates. Water discoloration, suggesting chemical or physical pollution, was noted in 37 percent of the streams. Natural seepage from unworked coal and other pyritic material - from both surface and deep mines - causes limited local pollution. Access roads built of pyritic waste material also may be sources of acid water.

195 Sediment is a problem where inadequate plant cover permits erosion and water is allowed to run off the site from roads, terrace outlets, outslopes, or slides. It is particularly severe in areas of high-intensity storms and steep slopes.

195 Sediment generally was not present in small streams more than 2 miles from the mine area. But of 14,000 miles of stream channels affected by surface mining, half have had their water-carrying capacity reduced; along 4,500 miles capacity was moderately reduced, and along 2,500 miles capacity had been affected only slightly.

195 Self-contained mining sites - quarries, dredged areas, and some area-stripped sites - do not have enough runoff to warrant costly storm-water

controls. Contour-stripped areas can be used to manage runoff in much the same way as broad-based

195 [See Map in Original]

{196} [See Graph in Original] terraces. But on 98 percent of the surface-mined land studied in Appalachia - where most contour stripping is done - storm-water runoff control was not adequate to prevent erosion, sediment, or flooding.

196 On these areas, vegetative and mechanical measures or a combination are needed. An example is the need for grading within some surface-mine pits to control storm runoff. About 75 percent of the sites need some grading, and only 45 percent have received any. Grading too much or on the wrong soil material, though, may make matters worse; special care and technical assistance are needed. In some areas of the West, minor reshaping of some banks is adding to the beauty of the landscape.

196 Ponds

196 Many surface-mined areas have ponds or depressions, especially where area stripping has been done. Forty-two percent of the ponds are smaller than an acre, 40 percent are 1 to 10 acres, and 18 percent are larger than 10 acres. Two-thirds are more than 5 feet deep.

196 Acidity is a problem in some ponds - one-fifth of those studied had a pH rating of less than 4.5. The other four-fifths are less acid and include the larger and deeper ponds that have greater potential use. Some are being used even for municipal water supplies.

196 Animal life was present in four-fifths of the ponds, but scarce in the acid ponds.

196 Effect on wildlife

196 Disturbing land and water for mining naturally disrupts wildlife habitat. State fish and game commissions reported to U.S. Bureau of Sport Fisheries and Wildlife that nearly 2 million acres of wildlife habitat had been damaged by surface mining - 68 percent of it east of the Mississippi River. Most damage resulted from:

196 [*] Stream widening, affecting water temperature and depth of spawning beds.

196 [*] Lake draining.

196 [*] Burying or removing spawning gravels.

196 [*] Diverting surface flow.

196 [*] Sediment.

196 [*] Chemical changes in soil and water quality.

196 [*] Removing food, nesting, and escape cover plants.

196 [*] Forming high walls that limit animal access or movement (a problem on about one-fourth of the high wall mileage studied).

196 Where proper restoration measures have been taken, fish and wildlife habitat has improved and often is better than before mining. Since the same kinds of wildlife use the mined site and adjacent land, there is opportunity for managing both areas together for wildlife habitat on private and public property.

196 Safety

196 One-third of the mined areas studied had some safety hazard, usually water. On 22 percent of the inactive areas there was evidence of abandoned buildings, equipment, debris, or rubble - some hazardous and nearly all unsightly. Ten percent had one or more deep-mine openings - without shaft sealing. Restoration measures, well planned and carried out, reduce the danger to public safety.

196 [See Illustration in Original]

{197} [See Illustration in Original]

197 Accomplishments

197 USDA's participation in surface-mined-land conservation began in the 1930's. The Forest Service then began research on revegetating mined land and keeping acid and sediment out of streams. The Soil Conservation Service at the same time began helping landowners improve their soil and water resources and solve many land use and land treatment problems, among them surface mining.

197 During one 5-year period, 1960-64, more than 5,000 land owners and operators in 500 local soil and water conservation districts in 31 States applied conservation measures to nearly 128,000 acres of surface-mined land with USDA help (table 3). The survey team noted that the conservation districts considered restoration of mined areas as part of the total conservation job on individual properties or whole watersheds and not a separate or special activity.

197 During the same 5-year period State foresters, through Federal-State cooperative programs, provided technical help to more than 1,250 ownerships in replanting about 37,000 acres to trees.

197 Industry

197 Many mining firms are giving increased attention to the challenge of surface-mined-land conservation. Reclamation associations formed in a number of States have their own professional staff to foster restoration work. Individual firms and their associations have restored many mined acres, conducted demonstration projects and experimental plantings, carried on substantial research work, and in general promoted effective conservation treatment of surface-mined land.

{198}

TABLE 3. - Surface-mined-land treatment by cooperators with soil and water conservation districts, 1960-64

State	Area	Landowners participating
	Acres	Number
Alabama	931	88
Arizona	1,000	3
Arkansas	809	66
California	3,246	116

Color ado	557	38
Florida	6,326	89
Georgia	970	252
Idaho	268	22
Illinois	6,367	94
Indiana	848	68
Iowa	122	18
Kansas	1,515	73
Ke ntucky	13,784	1,139
Louisiana	1,038	127
Maryland	403	16
Michigan	1,378	130
Mississippi	3,350	229
Missouri	2,546	33
Montana	4	1
Nebraska	1,896	194
New York	824	93
Ohio	23,613	433
Oklahoma	5,866	232
Pennsylvania	13,043	306
South Carolina	8,441	140
South Dakota	2,945	77
Tennessee	1,830	42
Texas	1,110	26
Virginia	10,102	58
West Virginia	11,890	887
Wisconsin	725	165
Total	127,747	5,255

198 [See Illustration in Original]

198 For example, reclamation associations in the Appalachian region have done reforestation and seeding on 74,000 surface-mined acres. The National Sand and Gravel Association's members rehabilitated 52 percent of the acreage they mined in 1965, compared with only 25 percent just 2 years earlier. Phosphate mining firms in Florida, between 1961 and 1966, voluntarily restored 75 percent of the acreage mined during that period. Where mines are near urban areas, many phosphate miners have made plans before mining for later development of the site as residential, commercial, or recreation areas. And surface-mine operators in 22 States have formed the Mined Land Conservation Conference to promote restoration of mined land for useful purposes.

198 Many other firms and commodity groups have yet to follow these examples and respond to the challenge of surface-mined-land conservation.

198 Government

198 Fourteen States have laws requiring restoration work, most enacted fairly recently. Their provisions are compared in table 4, with three exceptions. Georgia and Kansas enacted laws that call for establishment of State boards to license and regulate surface mining and enforce restoration. Montana's law authorizes its Bureau of Mines and Geology to enter into contracts with coal stripmine operators. Amounts spent for restoration work can be credited against the coal license tax. No bond is required. A restoration-plan map is called for that includes covering exposed seams, grading ridges that are near highways, constructing earthen dams, and planting recommended species for later forest or grazing use of the mined area. Work usually must be completed within 3 years after mining.

{199} In addition, Iowa, North Carolina, and North Dakota have established advisory boards or committees to suggest restoration programs. In Colorado, coal-mining firms and the State's Department of Natural Resources have a voluntary contractual agreement dealing with restoration. This arrangement will be watched with interest.

199 A few other States have some control over surface mining through water-pollution-control statutes.State funds have been made available to universities and foundations for research and demonstration activities.

199 Some local governments have used zoning regulations to control mining and require restoration of the land.

199 Beyond assistance to private-land owners, the Federal Government also has made some headway in restoring surface-mined areas on public land and is engaged in research work.

199 Research

199 USDA is the recognized leader in basic research on surface-mined-land conservation. Most research now underway in government and industry is in six categories:

199 (1) Revegetation - developing plant species that will provide quick cover or permanent growth and comparing various combinations of seedings. [See Illustration in Original]

200
TABLE 4. - State surface-mining licensure, bond, and reclamation requirements
Bonding Substitution Minerals License or requirement Reclamation of State covered permit required Refuse sites Conditioning to make suitable for productive use Including

forestry, grazing, cropping, wildlife, recreation, and building sites, according to a plan. Ridges tobe struck off a minimum of 10 feet for forestry, 18 feet for pasture, and graded to allow
use of
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machinery
for
cropland.
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species to
be used
must be
approved
by the
department
of
conservati
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material
to be
covered by
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water or be
other confined
material in
capable of depression
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best land
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or earth.
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of spoil.
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except
when
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plan before months of refuse or of
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and permit refuse,
logging or and other
grazing.   debris to
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isolated   so as to
peaks.   reduce the
Access   piles of
roads and such   Subject to
fire   material   approval
lanes.   and make   of
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on of   its   of
earth dams submergenc Reclamatio
in final   e in   n.
cut.   water. If Affected
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acre, with n complete covered by substitute
a minimum 2 years   water,   d must be
of $2   from   material   equal
Required.   ,000.   completion shall be   acreage to
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year, plus deposit is stripping. with   original
$15 per   acceptable Substituti overburden area
Ohio   Coal   acre.   .   on.   .   affected.
$5 0 per   Grading to
acre or   rolling
assessed   topography

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the land   acid
the   material
preceding with at
year,   least 2
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is lesser. soil.   approval
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Permit.   government will be   Department
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Oklahoma   All   fee   .   areas.   provisions Mining.
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permit. $3 regulating backfilled shrubs, or
00 per year agency may to 45 grass
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Mining and $1,000 per angle. year after
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200 [See Table in Original]

200 (2) Chemistry of overburden and spoils - identifying soil and rock mixtures, soil and water characteristics, and effects of fertilization and weathering.

200 (3) Hydrology - studying water and drainage effects, sedimentation, and ground-water movement and storage.

200 (4) Earth movement and placement - finding new or adapted equipment and methods for mining and more economical restoration.

200 (5) Haul roads - designing better and safer access roads as well as better hauling equipment.

200 (6) Land use potentials - making guidelines for finding the best use for a mined area consistent with the community land use pattern and needs, characteristics of the mined land, and cost-return factors.

200 There are many areas of study in which more research is needed to improve both surface mining and the reuse of the mined areas:

200 Comprehensive knowledge of physical and chemical characteristics of

spoil materials is needed, as well as interpretations or ratings of surface-mined-areas land use potentials or limitations.

200 Better methods are needed for lifting, moving, piling, and relocating overburden, especially on sloping land.

200 More knowledge is needed about the responses of many different plants and about their usefulness for landscaping, screening, protective cover, wildlife habitat, and soil building.

200 Improved methods of preparing surface and subsurface water storage are needed to make effective onsite water use and prevent pollution and excess runoff.

200 Potential and challenge

200 Properly planned, treated, and developed to blend with adjacent land use patterns, most surface-mined areas have great potential (table 5). Thirty-two percent of the areas surveyed provide an outstanding view of mountains, valleys, or lakes. Haul roads can open up many areas to visitors for the first time. Ponds can give an area greater economic value than it had before mining. And most areas can be kept in private ownership.

200 With today's growing land use demands, particularly farm and forest recreation, these opportunities deserve attention. The challenge to USDA is to assist in developing resource uses in surfacemined areas that will be compatible with one another and with uses of adjacent land.

200 A similar challenge is to make sure that the optimum benefit - both to the landowner and the community - is derived from each dollar spent in mining and land restoration. Some shallow deposits would better be left unmined where restoration costs would be prohibitive. Some mined sites would best be treated to prevent offsite damage but not developed. In some areas, mined land can be treated and managed for intensive use.

{203}
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TABLE
5. -
Potenti
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surface-mined areas in several States [In percent n1]

State	Cropland	Pasture land	Rangeland	Woodland	Wildlife habitat	Farm Ponds and reservoirs	and forest recreation	Residential, institutional, industrial	Other unspecified
Arizona	0.5	0.5	19.7	0.2	17.6	2.4	9.6	6.4	49.8
Arkansas	.3	6.2	14.7	44.4	15.5	10.0	6.8	1.1	1.3
California	.5	8.6	26.9	17.8	62.5	5.2	46.2	10.4	7.3
Florida	2.8	10.8	42.6	48.4	46.6	14.9	53.2	6.1	3.7
Illinois	15.2	49.6	.9	27 .3	31.8	9.0	28.9	7.3	3.0
Indiana	2.4	15.9	n(2)	55.9	49.2	12.7	47.5	12.9	6.0
Kansas	1.3	14.7	20.5	24.2	32.1	5.8	11.7	3.0	3.7
Louisiana	.2	2.8	n(2)	59.3	30.5	21.7	25.2	1.7	3.3
Michigan	3.3	7.0	.1	34.4	24.8	5.6	12.3	3.7	13.6
Missouri	.2	38.1	5 .8	42.0	39.9	8.8	18.1	2.2	17.6
Nebraska	1.3	13.0	23.1	5.7	37.3	30.1	49.7	8.9	3.4
Oklahoma	.4	56.8	32.4	33.2	50.6	10.4	25.6	14.1	1.7
Pennsylvania	10.0	20.0	n(2)	80.0	92.0	2.0	12.0	13.0	5.0
West Virginia	9.0	5.0	n(2)	75.9	10.0	.1	34.0	.5	.5
Average	3.4	17.8	13.3	39.2	38.6	9.9	27.2	6.5	8.6

203 n1 The percentages exceed 100 for individual States and the national average because more than 1 potential use may apply on some areas.

203 n2 Less than 0.1 percent.

{204} [See Illustration in Original]

204 Principles for a National Surface-Mined-Land Conservation Effort

204 The mining industry, conservation districts, and all levels of government should work together to put practical principles into surface-mining operations at every site:

204 PREPLANNING. - Make good mine housekeeping and practical restoration measures an integral part of plans for the site - before any mining activity begins. Include a plan for both interim and final land use where practicable.

204 STABILIZATION. - While mining is going on, take steps to control erosion on the site and on haul roads, including establishing quick-growing plants. Plant permanent cover to protect the area after mining, and reseed or replant where previous revegetation has failed.

204 STORM-WATER CONTROL. - Plan control of surface runoff on a watershed basis to fit stream capacities and prevent harmful sediment deposits.

204 WATER QUALITY. - Place highly toxic spoil material only where it can be covered with other overburden or a permanent body of water. Seal off auger holes and any breakthrough to former underground mines. Control drainage from sites and haul roads to keep toxic substances and sediment out of adjacent streams.

204 WATER STORAGE. - Create as many lakes as practicable, to aid water control and increase potential use of the mined site. Dams and ponds should be designed properly to guard against failure.

204 AIR QUALITY. - Help prevent offensive noises and air contamination by controlling use of explosives, fire, and motorized equipment.

204 NATURAL BEAUTY. - Plan operations so they have a minimum impact on the landscape. Make treatment work practical and pleasing to the eye.

204 HEALTH AND SAFETY. - Take steps before, during, and after mining to minimize hazards from equipment, structures, and water areas.

204 Mined land should be devoted to the highest and best possible uses compatible with the use patterns of adjoining land and with the geographic

location, topography, and other site characteristics.

{205} Information

205 Those involved in surface mining and restoration of the areas - and those who use the products - must be kept abreast of social, scientific, and economic developments that affect their efforts.

205 Education in both the program responsibilities and scientific aspects should be fostered by the Federal Government. Universities and colleges provide formal knowledge in this field; the less formal is supplied by trade schools, correspondence courses, field days and workshops, and on-the-job training.

205 Lectures, field demonstrations, and onsite guidance in solving mined-land problems - the how-to-do-it - would aid in extending new ideas, new methods, and new techniques.

205 Field trials or tests should be expanded to follow through on basic research in plants, techniques, and methods and to demonstrate their effectiveness. USDA offices located in nearly every county in the Nation can fill many of these information needs in their everyday dealings with local citizens and groups.

205 Leadership and assistance

205 Federal and State agencies should make use of experience gained in activities closely related to surface mining as guides to assistance in surfacemining operations and conservation.

205 For example, USDA has leadership in developing and interpreting soils information and in helping land operators make effective use of it. This

information with interpretations specifically for surface-mined land would have great value both in finding potential sources of surface-mine deposits and in restoring surface-mined land to safe, productive use.

205 Since the problems and opportunities concerning surface-mined land are largely on private rural property, USDA has a major responsibility to provide Federal leadership and assistance in its restoration.

205 The 186 million acres of National Forest under USDA jurisdiction are managed for mineral resources as part of overall resource management. Since much National Forest land is intermingled with privately owned land, the use and management of one is coordinated with the other to provide maximum private and

public benefits.

205 USDA works closely with private landowners and with State and local governments. Its assistance on private land is channeled through soil and water conservation districts, State foresters, and State and county extension programs. Each conservation district has a program that fits its local problems and is a central source of help in solving these problems. Most surface-mined land is in a soil and water conservation district.

205 USDA endorses the type of national mined-land conservation effort outlined in these pages. It is a use of the same principles USDA has followed for years in its cooperative work with private landowners. Accomplishments already made by soil and water conservation district cooperators, the mining industry, and Government show that such a program can do the job.

205 Conclusions

205 Proper treatment of surface-mined land is an integral part of the total resource conservation effort on private and public land. To this end, USDA recommends as a four-point course of action:

205 1. That Federal agencies demonstrate leadership by restoring their surface-mined land. Each agency managing public land should develop a plan for completing the job within 10 years. Each agency should establish adequate safeguards to prevent harmful effects from surface mining on its land in the future.

205 2. That treatment of old mined areas be accelerated. The Federal Government should participate with States, counties, municipalities, the mining industry, associations, conservation districts, private individuals, and others in developing long-range, comprehensive restoration programs - designed on a watershed or drainage-area basis. Federal technical and financial aid should be on a long-term contract basis.

205 3. That to deal with the problem of future rehabilitation of surface-mined land, Federal agencies extend their knowledge and assistance to States and producers of the 50-odd commodities involved. Technical information should be disseminated as it is developed.Federal agencies should study existing State statutes on mined-land restoration (table 4) and develop model statutes. The goal should be the blending of knowledge and trust between all levels of industry and government in the interest of mining with a minimum of adverse effects.

205 4. That Federal research programs, studies, and field demonstrations

be expanded. Many problems of treating mine spoils have not been solved and many opportunities remain unrealized. Present research efforts are inadequate. The problems examined in this report need specific attention.

{206} [See Illustration in Original]

{207} [See Illustration in Original]

SELECTED READINGS

RECLAMATION

After the Mining . . . USEFUL LAND

207 By DARNELL M. WHITT Soil Conservation Service U.S. Department of Agriculture

207 [See Illustration in Original]

207 Mine operators in increasing numbers are looking at the opportunities for turning mined areas into useful, profitable and attractive tracts. The Soil Conservation Service of the U.S. Department of Agriculture stands ready to aid owners of mined land through 3000 soil and water conservation districts across the country

207 THE SCIENCE of strip-mine reclamation is comparatively new and still developing.

207 Yet proof of achievement in this field lies in the hundreds of thousands of acres which are witness to the skills of the soil scientist, the agronomist, the wildlife specialist, the land use planner, and their associates. For over 30 years they have been guiding the changing of torn earth into useful and attractive pockets of countryside.

207 An equally encouraging word reflects the interest of the mining industry in responding to the growing national concern over the quality of the rural environment.

207 Two million acres could benefit from reclamation

207 The National Surface Mine Study, under Public Law 89-4, turned up the information that 3.2 million acres in this country had been disturbed by surface mining. Of this, more than two million acres would benefit from conservation treatment to restore the disturbed areas to productive, stabilized, and attractive condition.

207 The remaining acreage - a little over a million - needs no treatment. Over half of this was reclaimed or stabilized through the efforts of the

mining industry, individual owners, or some unit of government. Nature herself, with processes slow and methodical, took care of the rest, using her own adapted grasses, shrubs, and trees.

207 [See Illustration in Original]

207 Soil Conservation Service offers assistance

207 The Soil Conservation Service of the U.S. Department of Agriculture, which since the 1930's has been dealing with strip-mine reclamation along with its regular problems of soil erosion and land use, offers its assistance to owners of strip-mined land through the nation's 3000 soil and water conservation districts.

{208} [See Illustration in Original]

208 The districts, subdivisions of state government, have been carrying on their own effective campaign to restore surfacemined lands to usefulness and beauty. In the five-year period from 1960 to 1965, more than 5000 land owners and operators in 500 districts used SCS technical help, through the districts, to apply conservation to nearly 128,000 acres of surface-mined lands in 31 states.

208 The districts consider the restoration of strip-mined lands a part of the total soil and water conservation job, not a separate activity. Many mining firms, in cooperation with the conservation districts, have used the help available to solve strip-mine reclamation problems. Individual companies and their associations have reclaimed many thousands of surface-mined acres.

208 In the Appalachian region, reclamation associations have done reforestation and seeding on more than 74,000 acres. From 1961 to 1966, phosphate mine operators in Florida voluntarily restored 75 percent of the acreage mined. The National Sand and Gravel Association's members reclaimed more than half the land disturbed in 1965.

208 The National Coal Association, whose members account for over a third of the strip mining now being done, encourages its members to develop plans for reclamation before the mining machinery moves in. An Ohio coal mining company takes aerial photos of land to be mined. The negatives are projected on a plotter which traces contour lines on a map. A computer then reveals the amount of overburden that must be moved and indicates where it should be placed for

both mining and reclamation work.

208 The Department of Agriculture, pushing ahead in its effort to raise the living standards of many of the nation's rural communities, looks at reclamation of strip-mined areas as one of its clear opportunities.

208 [See Illustration in Original]

208 Reclamation for recreation is one land use option

208 The SCS believes that more than a fourth of the disturbed land can be reclaimed for recreational uses. More than a third would support woodland plantings, and another third would serve well in range and pasture. Some of the remainder would be productive cropland and some would be desirable for

residential, industrial, and institutional development.

{209} [See Illustration in Original]

209 Ponds and reservoirs, often a possibility in strip-mine reclamation, can be developed for a variety of uses.

209 Near Lakeland, Fla., a 740-acre tract turned over to Polk County by phosphate mining firms has been developed as Saddle Creek Park - an expanse of nature trails, camp sites, playgrounds, a marina and other facilities for water-based recreation. Another tract, leveled and filled according to a mining plan, is being developed for homesites.The companies cooperating with the Polk Soil and Water Conservation District have had technical help from the Soil Conservation Service.

209 Near Port Washington, N.Y., grading and planting have brought usefulness and beauty to many mined areas. In Missouri, a landowner built an attractive recreation area on 42 acres of strip-mined land he bought in 1953. The SCS, the U.S. Forest Service, and the Missouri Department of Conservation gave him a hand through the Callaway Soil and Water Conservation District. The Agricultural Conservation Program, another USDA activity, furnished trees and shrubs.

209 [See Illustration in Original]

209 West Virginia soil conservation districts have been helping landowners restore surfacemined lands for many years. The districts employ crews experienced in planting grasses, shrubs and trees.

{210} [See Illustration in Original]

210 Disturbed land exists in all states

210 All states have areas of land disturbed by strip mining and needing conservation work; although Hawaii, with 300 acres, barely qualifies for the list.

210 There are at least 13 states that have 50,000 or more acres needing reclamation. These are Pennsylvania with 229,500; Ohio-171,600; Florida-143,500; Texas-136,400; West Virginia-111,400; California-107,900; Illinois-88,700; Alabama-83,000; Kentucky-79,200; Minnesota-71,500; Tennessee-62,500; New York-50,200; and Kansas-50,000.

210 Information gathered by SCS shows that over nine-tenths of the mined acreage needing conservation treatment is in private ownership, most of it in small scattered parcels. The small tracts can usually best be treated along with the rest of the farmed area in a conservation farm plan.

210 Most of the mined areas are shown to be within five miles of communities of 200 or more residents. About 40 percent are more than five miles from towns of this size.

210 Control of pollution of mounting importance

210 In the more than 50 Resource Conservation and Development Projects around the country, with the Soil Conservation Service giving technical help, unreclaimed strip-mine areas are inevitably examined by local planning groups for their potential uses.

210 It is the same in the national Small Watershed Program assisted by USDA. Land treatment gets priority rating as the conservationists seek out erosion and other sediment-producing sources.

210 With water pollution an increasing concern among conservationists, the control of pollution from mining sites is mounting in importance. Of sites surveyed by the national study, over half showed no pollution; 23 percent showed intermittent pollution and 21 percent showed substantial pollution.

210 The SCS reported that about a third of the mined areas needing conservation treatment should have some action to reduce offsite water pollution. This amounts to about 665,000 acres.

210 Of streams receiving direct runoff from surface-mined areas, nearly a

third of those studied contained noticeable quantities of mineral precipitates. Another third or more showed water discoloration indicating chemical or physical pollution.

210 Of 14,000 miles of stream channels affected by surface mining, about half had water-carrying capacity reduced by sediment. An additional 4500 miles of channels had capacity moderately reduced. Along 2500 miles, channel capacity was only slightly affected.

210 Industry moving ahead of requirements

210 The surface-mining industry is giving increasing attention to the restoration of mined areas and appears to be moving ahead of regulatory requirements. Operators in 22 states have formed the Mined Land Conservation Conference to promote reclamation of mined areas. These efforts appear to be producing impressive results.

210 Twenty states now have laws requiring mining operators to restore mined lands.Most such laws have been enacted within recent years. Reduction of pollution is high among the objectives of state laws. The trend in regulation is toward requiring that arrangements for restoring the mined area be made before license or permit to mine is granted.

210 Opportunity to turn mined areas into useful, profitable and attractive tracts, blending with the surrounding countryside, is claiming the attention of an increasing number of mine operators as well as that of conservationists and concerned communities. Experience has shown that most surface-mined areas offer great potential. This, with the development of new skills and materials in restoration work, can be expected to keep progress at least on a level with today's land use demands.

210 [See Illustration in Original]

{211} [See Illustration in Original]

211 WESTERN MINING'S LAND RESTORATION EFFORTS

211 By EDWARD H. PEPLOW, JR. Executive Secretary Arizona Mining Association

211 "The time has come, the Walrus said, To talk of many things, Of dikes and dumps and tailings ponds, Of Ringleman's dark rings."

211 WITH APOLOGIES to Lewis Carroll and a bow to President Nixon, the decade of the seventies is indeed that of the environment. It must also be the decade

of abandonment for the mining industry - abandonment of its traditional reticence, its appearance of aloofness, and its surprising timidity.

211 In all of the fields of environment control, the mining industry, judged by objective standards, has a highly creditable performance record. In Arizona, for instance, early in 1970 the copper industry published the fact that since 1965 it has spent or committed to be spent some $1 00 million on devices and equipment which diminish the contaminants emitted into the air by its smelters and other operations. Just in the last few months that expenditure has been swelled significantly, and the expectation is that it will continue to rise until the job is done.

211 Public reaction to facts only mildly favorable

211 Still to date public reaction to the facts has been only midly favorable. In public meetings industry spokesmen state the facts, then ask whether any other segment - or all other segments combined for that matter - of Arizona's economy can make defensible claims even remotely approaching the copper industry's demonstration of progress and sincere effort. The public response too often is, "Well, yeah, but. . . . !"

211 We have all become accustomed, over what seems an endlessly long time, to spokesmen for the industry and for government telling industry leaders that the industry must "seize the initiative," "buy time," educate the public," "sell its story nationwide." Then, when the effort is made (at considerable effort and expense), the response scarcely seems to justify the trouble. The old system of stubborn defense and quiet infighting could be best after all.

211 True . . . except for one new and apparently immutable fact: the public voice in matters of the environment is not going to be muffled. It may occasionally seem to grow less strident; but it must be accepted as one of the facts of life with which the mining industry is going to have to live for the foreseeable future.Ignoring it will not make it go away; it will make it much, much worse.

211 It has been suggested that the most effective first step in mounting a counter-offensive is to muster the facts of the industry's environmental case in one place in readily usable form. A fine idea, of course, except that no one has volunteered to donate a large library, a major computer and a staff of experts in the art of popularizing highly complex technological material.

211 Thus Mining Congress Journal has made a feasible start by scheduling a series of articles on environmental accomplishments of the mining industry. This, the first installment, concerns reclamation and restoration of surface disturbed land. Others will follow on air and water.

211 Industry story told in bits and pieces

211 For two reasons the industry's story regarding its efforts to ameliorate its effects upon the land has been told, at best, in bits and pieces. First, operators have a defensible reluctance to embarrass their colleagues by publicizing individual successes. The public's reaction to any success story predictably is, "They did it there, so let's force them to do it here."

211 Second, the problems of land reclamation (perhaps especially in the West) are so complex and diverse that it is difficult to explain the intricacies without appearing either to defend or to rationalize. The ugliness of "raped landscape" can be dramatized by the camera at least as effectively as can polluted air, and unfortunately the average citizen has acquired such an habitual faith in science's agricultural ability that he tends to think we can grow almost anything almost anywhere.

{212} [See Illustration in Original]

212 Finally, much too often, discussion reaches the conversational impasse:

212 "Unfortunately, part of the price we must pay for the minerals which sustain our nation's industry is a certain, minimal disturbance of the landscape."

212 "Yeah? Well, I'm not willing to pay that price! I say we should recycle, import or do without."

212 Scenic values surround Henderson project

212 The impasse is not inevitable, however. In Colorado two groups of intelligent, fair-minded people proved that. When American Metal Climax was determining whether it had a minable ore body at its Henderson project, a major factor in establishing feasibility was control of the effects of the potential operation on the landscape. If the company could not use the landscape for waste disposal and other inescapable facilities, obviously there could be no mining. If impossible restoration and reclamation requirements were forced on the company, the $200 million development would be rendered infeasibile.

212 On the other hand, the deposit itself was located in some of Colorado's most scenic country, while possible waste-disposal areas presented serious difficulties either of engineering, of preservation of natural beauty or both. If the nation was to reap the benefits of the store of molybdenum nature had deposited there, resolution of the difficulties inherent in the situation had to be reached in advance of the company's committing itself to a plan of action.

212 Such resolution was attained by the now well known Experiment in Ecology. Over a prolonged period, the company met with leading environtalists as represented by such organizations as Thorne Ecological Foundation, the Colorado Open Space Council, and the Rocky Mountain Council on Environment.

212 Even while the company was still engaged in measuring the deposit and making the multitude of other determinations on which the final decision whether or not to mine is based, it called on the various environmentalist groups of the state. In effect, Amax said to them, "We are considered experts in the intricate mining problems presented here. But you represent the resident expertise in the environmental field. We realize there are many potential serious conflicts. Let's work together now, in advance, at least to minimize,

if not eliminate, these."

212 Resolution of differences wasn't easy

212 According to participants on both sides, it was not like magic. The problems did not disappear overnight. There were times when differences seemed insurmountable, when the painfully slow progress did not seem to warrant the many, many man-hours of very basic rethinking of values it cost.

212 Over the course of months it became evident that what they were discussing was whether, in this specific instance, the benefits to the local community, the state and the nation accruing from mining were as great as or greater than the benefits from totally undisturbed landscape. Anyone who has ever become embroiled in such a discussion for even a few minutes knows it can get pretty doctrinaire. "Do you want to maintain civilization or regress toward the Stone Age?" "Do you want wantonly to destroy ecosystems with the result that very soon man will be unable to survive on this earth?"

212 The happy ending, of course, is that the Experiment in Ecology succeeded in evolving a plan with which both sides can live, a plan by which Climax can mine the deposit even while giving maximum consideration to preserving the ecological values of the area involved. A start, at least, was made toward a value structure in which the greatest good for the greatest number was truly the criterion in both the short and long term views.

212 Precedent set was significant

212 But, to those who have watched the Experiment in Ecology with close interest, perhaps its most significant contribution was its establishment of a precedent. It did not resort to legal strictures. It did not argue its cases

in the public prints. It did not invoke high emotionalism and panic as bases of action.

{213} It did prove that right-minded people, working together in mutual trust and respect, can eventually arrive at a course of action acceptable to both, yielding most of the benefits each seeks, and avoiding most of the damages each fears. Actually it is not such a brand new idea; the Quakers have been preaching it for centuries.

213 Voluntary beautification assumed at Twin Buttes mine

213 Not all properties demand this sort of approach, of course. When the Anaconda Co. undertook, in 1964, development of an open-pit copper mine at Twin Buttes, south of Tucson, Ariz., management unilaterally made the decision to devote special planning to disposal of waste material and tailings. There was no legal compulsion involved to force the program which would entail major expenditures simply for beautification.

213 The factors Anaconda considered were that within three miles of the mine site were the new retirement community of Tucson Green Valley, a residential development, several planned subdivisions, considerable farm property, an Air Force missile base, and the proposed route of an interstate highway.

213 The problem, obviously, was to make the mining operation blend into the surrounding landscape as gracefully as possible. The major factor in its solution was the fact that to attain mill production the company had to remove from the ore body more than 230 million tons of alluvial overburden, while a substantially greater amount of alluvium will be removed in the course of future pit expansion.

213 The decision was to use this vast tonnage of alluvium to build dikes to impound the mill tailings. The hope was that the alluvium, essentially the same material as the valley fill throughout the Santa Cruz Valley in which the property is situated, could be made to support the same desert plant life as that on the surrounding valley floor. If it could, the visual impact of the operation would be minimized, as would disturbance to the ecosystem.

213 Not all environmentalists antagonistic to mining

213 So would the predictable public outery. And, of course, it is at this point that another predictable public reaction occurs. Antagonists of the industry are quick to point out that while no legal compulsion forced the beautification program, the fear of public reaction did. So what? The

important fact is that the job was done, for whatever reason, and the company was a sufficiently good citizen to do it voluntarily and to engineer it into its plans from the very beginning.

213 A happy aside is that not all environmentalists are antagonists of the mining industry. Anaconda was honored as the Arizona Conservation Organization of the Year 1966 by the Arizona Game Protective Association, National Wildlife Federation and Sears Roebuck Foundation.

213 [See Illustration in Original]

213 The Twin Buttes plan has proved to be a good one, and ultimate success seems reasonably predictable. But it has encountered a great many difficulties. The dikes were terraced to facilitate planting and care. Yet the problem of soil sterility has been difficult and continuing. The alluvium dug from only a few feet beneath earth surface was found to be completely lacking in the soil bacteria and microorganisms necessary to support plant growth.

213 Tenacious experimentation seems to be solving the problem of introducing these factors and also of determining what grasses, trees and shrubs will make most rapid growth and survive best. Anaconda has a staff agronomist in charge of the program, while it has availed itself of the cooperation of the University of Arizona, federal agencies, private nurserymen and local farmers. Its own engineers and equipment manufacturers alike have been called on to devise the special mechanical equipment needed for the job.

213 Even the advice of local experts in aesthetics has been heeded. There were those who objected to the flat tops of the dikes; they were said to be unnatural in appearance, despite the fact that the surrounding desert is marked for miles around by extensive flattopped mesas. Accordingly, flat lines of the tops of the dikes probably will be relieved by irregular mounds as work progresses.

213 Experience shows you can't please all

213 Three significant conclusions seem to emerge from the Anaconda experience at Twin Buttes. One, of course, is that you can't please

everybody; there still are angry attacks against the disturbance to the landscape, although they are certainly less numerous and violent than they might otherwise have been.

213 Two, working with even such a tremendous initial asset (perhaps a unique asset) as Anaconda had in its alluvium, there is no easy way of accomplishing

the high goals of preservation of ecosystems and natural beauty. The engineering problems and the specific problems of agronomy add up to major difficulties which can be solved only at great expense and effort over the course of years.

213 And three, there are, as Amax and others have also proved, immense advantages to programming reclamation and restoration efforts into a property in the very beginning. Let it be emphasized immediately, however, that this is not a convincing argument in favor of federal or even state laws governing restoration and reclamation. Quite the contrary. It is demonstrable that each property involves such individual problems that an effective program has to be more carefully tailored than a plaid suit for a fat woman.

{214} [See Illustration in Original]

214 For example, only some three miles away from the Twin Buttes property is the recently dedicated Sierrita copper-molybdenum mine of Duval Corp. The two would seem to the casual observer to be so close that what would work for one surely would work for the other. Yet the ores, the geologies, the overburdens, almost everything are basically so different that the two might as well be in different states or countries. Duval has its own essentially different beautification program, therefore, and only the broadest, most flexible and general law possible could have dictated the formation of the two plans. The fact that both plans came into being without the compulsion of law, of course, is the final and most convincing fact.

214 Wyoming requires preplanning of reclamation

214 This variety in problems is reemphasized by the wide variety of conditions of rainfall, soil and climatelife-zone found in just the western states. In Wyoming, for example, one major coal producer faced the problem of revegetating reclaimed lands in an area where precipitation is about six in. per year. Another coal company in the same state had a much easier problem in an area with 16-18 in. of rainfall. The latter has succeeded in building a lake with good fishing and surrounded by lands supporting excellent growth of grasses, trees, and shrubs in which game birds thrive. The former is still wrestling with the basic problem of aridity.

214 The question of legal compulsion in Wyoming has been resolved by passage of a law in 1969 requiring reclamation of surface mined lands. It is administered by the State Commissioner of Public Lands and calls for preparation of a plan for reclamation of disturbed lands acceptable to the commissioner before a permit is issued the mine operator. In effect, it forces preplanning.

214 On the other hand, commendable as preplanning might be, the experience in Idaho of the Bunker Hill Co. sheds an interesting light. In the early days

of mining at Bunker Hill, the jig tailings were pumped onto a large flat on the outskirts of Kellogg, where they lay for many years. Then the area was leveled off and served as the county airport.

214 Later, in the late 1950's, the airport was moved and Bunker Hill began to remine the old jig tails. This effort has now been completed, and in an area of about 100 acres once used for jig tailing storage, a 70-lot FHA approved housing subdivision has been developed and almost completed. Another 12 acres have been committed for construction of a large shopping center; the new Kellogg Junior High School occupies another 25 acres; and a 40-unit apartment complex will occupy another 5 acres. In another two years, the company says, the whole of that area once disturbed by mining wastes will be completely and productively utilized.

214 Tailing pond project astounds agronomists

214 This is an ideal success story, of course, and one that every mine operator and city-planning environmentalist in the West would like to be able to duplicate. Unfortunately, or fortunately, the variety factor enters the picture again. At Miami, Ariz., Miami Copper Co. in the late 1950s abandoned its Solitude tailings pond. It was full.

214 Something more than 400 acres in extent, the pond lay in a natural bowl, surrounded on three sides by desert mountains and blocked on the other by a dike of copper tailings. At that time relatively little was known (compared to today's still skimpy knowledge) about revegetating such areas. Accordingly, Miami set out on its own and planted a shotgun mixture of hundreds of varieties of seeds by many different techniques.

{215} The effort was to establish a vegetative cover in harmony with the surroundings, one that did not require irrigation or other special care, and which would lead to a line of ecological succession which would, in effect, be self-sustaining. The immediate problem was to stabilize the surface to prevent the nuisance of blowing tailing dust.

215 The overall accomplishment, however, has been one that astounds many agronomists and ecologists.At the low, inner end of the old tailings pond there is year around (except for the most severe drought years) a small lake of runoff water which varies in size from as much as 15 acres or more on down. Here resident and migratory birds proliferate, while a wide variety of other wildlife, including deer and cougars, thrive. The balance of the old tailings are supporting a wide specitrum of indigenous and exotic plant life, and the whole aspect is fast becoming that of a beautiful low-mountain meadow.

215 To most ecologists this is the happiest possible end to the story, and to the company it is sufficient. But for other environmentalists the difference between Miami, Ariz. and Kellogg, Idaho, is unfortunate.Neither at present nor in the foreseeable future is there any prospect for this ideal dwelling site to be utilized. For the industry, as for the ecologists, it is enough that the job has been done and an ecosystem is rebuilding so successfully.

215 Success at Solitude not publicized by company

215 Yet one of the company's great concerns for several years was that its success with the Solitude would boomerang in the form of embarrassment to itself and its neighbors. There are within the same immediate district tailings ponds and dikes which have not been amenable to the same sort of treatment. Some are sheer faced, so that efforts to cover them with top soil have been futile. Others crust over almost like concrete when they dry out and make revegetation

impossible. Others, the surfaces of which are far more visible from the highway than is the Solitude (which is, in fact, impossible to see from the highway), are still active and thus can not be planted.

215 Thus for a long time Miami declined to talk about the Solitude experiment with anyone except its colleagues in the industry who were undertaking similar experiments, and even they were pledged not to publicize it. Now, however, the company has had time to redesign its newer dikes to include terracing and to achieve successes in a program for vegetating the faces of these active impoundments.Today a tour, including the Solitude, of the Miami property is a fascinating demonstration of what can be done under certain conditions, what is being done in modern operations, and of how much easier the industry's problems would be today had our predecessors of several decades ago been as forethoughtful as today's mine management is contrained to be.

215 Experiments being conducted by scores

215 Throughout the West scores of companies are conducting experiments in land reclamation and restoration, trying to find means of accomplishing the goals they now hold in common with enlightened ecologists. And in turn, the ecologists are now including among the factors which comprise our total environment considerations of technological ability and economic feasibility.

215 In New Mexico, Pittsburg and Midway Coal Mining Co. is actively leveling and trying to revegetate waste dumps at Gallup, while Phelps Dodge Corp. is conducting trout plant studies at Mangas Lake. In Nevada, Kennecott Copper Corp. is experimenting with both chemical and vegetative stabilization of tailings. At its Ray Mines Division in Arizona, the same company has recently

redesigned its entire tailings disposal operation with a view to better stabilization and possibilities of beautification.

215 J. R. Simplot Co. is replanting waste dumps at its Gay and Conda mines in Idaho, and Monsanto Co. is planting waste dumps at its Ballard mine in Idaho. At Western Energy Company's Colstrip mine in Montana, areas have been converted into wildlife habitat and fish ponds, while its neighbor in the state has been working on a program of physical stabilization of waste dumps.

215 Again in Colorado, Idarado Mining Co. has recently announced a master plan which envisions a 127-acre tailing pond surrounded by a golf course, commercial sites, residential areas and extensive greenbelt open space. Idarado will do the mining and leave the resort aspects of the project to a single developer with the required expertise.

215 Thinking in mining industry changing markedly

215 Perhaps the last statement is the best indication of how far thinking of the mining industry of the West has progressed in recent years. Not too long ago anyone suggesting, to either a miner or a resort developer, that a proper resort could be built around a mining property would have been laughed out of face.

215 It also suggests that many mining companies are calling on outside expertise for help in solving problems of land restoration and reclamation. For instance, Day Mines Inc. at its Dayrock mine near Wallace, Idaho, called in a professional landscape service from Spokane, Wash., to plant its tailings dam

with grasses and to apply the needed fertilizer and mulch. It was following the example of Hecla Mining Co. which had demonstrated that waste dumps could support both vegetation and operating plants.

215 The list of experiments and successes could be lengthened almost endlessly.Phelps Dodge Corp., for example, recently announced that it is inaugurating a major environmental research program, encompassing all of the aspects of mining's impact on the environment, which will be under the direction of Dr. J. D. Forrester, who resigned as dean of the College of Mines, University of Arizona, to accept the assignment.

{216} Elsewhere, companies are undertaking joint ventures in restoration and reclamation where environmental conditions are nearly common. An example is in the phosphate lands of the Pocatello-Soda Springs area of Idaho. There Monsanto, Simplot, FMC Corp. and El Paso Natural Gas Co., with the cooperation of the U.S. Forest Service, are engaged in such a project.

216 Government agencies providing expert help

216 In almost all instances the companies are counting heavily on the help of the U.S. Bureau of Mines, the U.S. Forest Service, U.S. Soil Conservation Service, state universities and similar agencies which can supply not only a pool of experience, but also specific expertise.

216 In many cases companies have engaged leading ecologists as consultants to help appraise the probable effects of a proposed development on the environment and to suggest means of minimizing deleterious effects. More and more companies are seeking the opportunity to participate in conferences studying the industry's impact upon the environment and the broad aspects of environmental control in general.

216 One now well established annual affair of that kind is Thorne Ecological Foundation's Seminar on Environmental Arts and Science at Aspen, Colo. A more recent innovation is the conference on mining and the environment held at Rolla, Mo. in 1969 and repeated in Tucson, Ariz., this year as a conference on mining and ecology in the arid regions. A number of mining schools of the West were the original sponsors and have been joined by other organizations in subsequent meetings.

216 Mining industry really environment conscious

216 All of which adds up to proof of the fact that the mining industry has indeed become environment conscious. It has taken the initiative in ameliorating its effects upon the landscape. It is making positive progress in land restoration and reclamation. It still has many problems to solve; it has been surprised to discover that its problems in this field are similar in complexity to the problems involving air and water, and its limited successes in communicating this fact to the general public has likewise surprised the average citizens who have assumed you could grow almost anything anywhere if you just tried hard enough.

216 But mostly it demonstrates a fact which the mining industry must work hard to bring home to the general public: the mining industry of today has a corporate conscience. R. D. Lynn and C. J. Hansen of the Anaconda Co. said it well when in 1968 they delivered a paper at an American Mining Congress meeting on the subject of reclamation practices at Twin Buttes, Ariz.

216 "From a philosophical standpoint, a primary ingredient in the success of such work is motivation. The decision to undertake this landscaping project was

made voluntarily out of an intention to operate as a corporate good neighbor. This element of free choice nourishes that very human desire to persevere through trials, errors and adversity in order to make one's own ideas prevail. It is doubtful that any such incentive would apply to a reclamation program imposed by legislation or governmental regulation."

216 [See Illustration in Original]

{217} [See Illustration in Original]

SELECTED READINGS

RECLAMATION

The coal industry went all out in 1970 to help rescue the country from a severe coal shortage. Much of the coal that replenished the dwindling stockpiles came from a sharp expansion of strip mine operations, and the result was a marked increase in the amount of land left for reclaimers to grade, seed and tend. But in spite of the emphasis on production, reclaimers still managed to check in with an impressive total of 58,060.34 acres of officially-approved reclaimed land.

217 The boom in stripping coincided with a new national awareness of the environment and prompted a move in Washington toward a federal reclamation law. By February, 1971, four reclamation proposals were in the Congressional hopper and the National Coal Association, representing major strip mining companies, announced it would not oppose federal legislation which would aid the states and operators in restoring land to productive use.

217 Carl E. Bagge, president of NCA, said that the association is not opposed to "federal legislation realistically designed to assist the states and the surface mining industry in the reclamation of disturbed areas."

217 "State authorities are, of course, most familiar with their particular areas of concern and are best qualified to set specific requirements and regulations. The federal government, however, can furnish leadership in such areas as research, training of personnel and coordinating state programs," Mr. Bagge said.

217 There are already laws in most coalproducing states, and most of the proposals now before Congress would encourage the states to set and carry out their own reclamation plans. The Administration's proposal, called for by President Nixon in his special environmental message, was sent to Capitol Hill early in February by Secretary of the Interior Rogers C. B. Morton. Written to regulate the "environmental consequences of surface and underground mining," the bill would require adequate state laws properly enforced. Where states do not

live up to national standards, the federal government would intervene. [See Illustration in Original]

{218} All minerals, not just coal, are covered by the proposal, and surface manifestations of deep mining, such as subsidence, mine drainage and refuse piles, would be controlled by the regulations. The bill is open-ended, giving

ultimate authority to the Secretary for establishing and enforcing regulations. Where mined areas cannot be "adequately reclaimed" the government could order mining stopped.

218 In a second proposal, Sen. Henry M. Jackson (D-Wash.) and Rep. John P. Saylor (R-Pa.) introduced surface mining bills which would place initial responsibility with the states but would provide for federal intervention. Recognizing that nationwide uniform regulations are not feasible, "because of the diversity of terrain, climate, etc.," the bill would allow each state to propose its own plan. Sen. Gaylord Nelson (D-Wis.) has proposed a similar bill. Rep. Ken Hechler (D-W. Va.) goes farther than any of the other lawmakers by calling for a halt to all coal strip mining in the country and all underground mining in national forest areas. Mr. Hechler's bill is in keeping with one supported by West Virginia's Secretary of State, Jay Rockefeller: Rockefeller has endorsed a ban on all coal surface mining in West Virginia. [See Illustration in Original]

218 Out of the 22 states which strip mine coal, 19 (which account for more than 95 per cent of all strip coal produced) already have state laws spelling out the requirements for reclamation. Missouri and New Mexico, two of the states which do not yet have laws, have bills before current sessions of their legislatures.

218 The provisions of the states vary according to terrain and the needs of each area, but there are common denominators, found in each of the laws. All states, for instance, require mining permits and peracre performance bonds which are not released until the reclaimed land has passed state inspection, and all require grading the land.

218 The laws differ in detail, but typically they require that the land be planted, either to trees or to grasses. In some states the option of the ultimate use of the land is left up to the operator, but he must meet state requirements governing that specific use. In these states reclamation can take the form of water impoundments, recreation areas, forests, pastureland or homesites. Provisions for covering toxic materials are spelled out in several states, and most laws call for a reclamation plan to be submitted before mining even starts.

218 Most states will not approve land as reclaimed until vegetation has withstood the rigors of more than one season and shown that it will provide permanent cover for the mined area. For this reason, the number of approved acres reported by the states each year does not represent the amount of actual reclamation that took place. In Ohio, for instance, officials inspect growth two years after it has been planted. Consequently, the land stripped during 1970, a year that saw a boom in stripping, will not show up on reports until later years. [See Illustration in Original]

218 The rundown for 1970 looked like this.

218 Alabama

218 Alabama's first reclamation law went into effect in October, 1970, with operators given the option of choosing the kind of reclamation to be performed. Total reclaimed acreage for the year, including the months prior to the enactment of the law, came to 962 acres, with the majority seeded to pine

trees.

218 Arizona

218 Arizona does not have a state reclamation law but mined land there comes under the regulations written by the Department of the Interior for the protection of Indian lands. A good deal of attention has been focused on the state because of Peabody Coal Co.'s impressive pre-plan for reclaiming the Black Mesa which it will be mining over the next 35 years. The New York Times, in a January article on Peabody's efforts, characterized the reclamation plan as one which would not only return the land to its original condition but actually improve and beautify it.

219 Colorado

219 Colorado entered its second year under a new strip mining law during 1970, and coal companies reclaimed a total of 329 acres. More than 6,000 pounds of grass and legume seeds were used to accomplish the job.

219 Illinois

219 Illinois, one of the first states to do volunteer reclamation, now operates under a law which allows coal operators to choose the mode of reclamation for mined land. As a result the state has several recreation areas, productive farms, tree farms and woodlands - all on former strip mines. Last

year 5,252.13 acres of Illinois land were approved as reclaimed. Almost 2,800 is scheduled for crop production and more than 2,800 became grazing lands. The rest was reforested or became recreation areas.

219 Indiana

219 Indiana inspectors approved 3,938 acres of reclaimed Hoosier land in 1970, which is 629 acres more than were affected by stripping during the same year. Land seeded to forage accounted for 2,274 of the acres; 1,246 went to trees and 418 became access roads and lakes.

219 Iowa

219 Iowa, completing its second year under a new reclamation law, affected 60 acres by coal mining and reclaimed 78. Several of the acres reclaimed were adjacent to lands mined before the state's law was passed and operators simply extended their reclamation to include the pre-law acres.

219 Kansas

219 Kansas, like Indian, topped its mining acreage with its reclamation acreage. During the second year under a state reclamation law, operators planted 920 acres in 1970, compared to 820 mined.

219 Kentucky

219 Kentucky was one of the states in which stripping activity leaped beyond previous years. In 1969 the state had 183 separate stripping operations: by 1970 that figure had increased to 342. The Division of Reclamation, Department of Natural Resources, hired 20 new people during the year to cope with the

department's increased work load. Field personnel spent most of their time inspecting active operations and examining land for issuance of mining permits rather than inspecting land for grading and vegetation releases. Kentucky operates on a fiscal year and the figure for approved reclamation work will not be complete until June 30, 1971. However, by the end of January, 1971, the state had approved 11,703 acres of reclaimed land. Officials say that more acres would undoubtedly have passed inspection had the time and personnel been available earlier to approve them.

219 Maryland

219 Maryland planted 389.50 mined acres in 1970.Included in this figure are areas that were replanted after a second growing season showed plant survival

under 70 per cent. (Several states have similar requirements.) These areas were reinforced with more trees. In places where erosion seemed likely, grasses were planted before trees. Maryland reclaimers planted 162,000 white pine last year, 120,000 red pine, 56,000 Scotch pine, 32,919 black locust, 10,143 hybrid poplar and 2,000 yellow poplar. In Western Maryland, a five-year roundup shows that 1,250 acres were affected by stripping. Reclamation efforts there outstripped the stripping with 1,245 acres backfilled and 1,284 planted.

219 Missouri

219 The "Show Me" state increased its acreage of legumes and grasses as coal operators there reclaimed 1,229 acres last year.

219 Montana

219 Montana's coal production is relatively modest and, because of its thick seams, the land disturbed in stripping is minimal. Last year, operating under its new law which became effective in January, 1970, the state reclaimed 20 acres.

{220} [See Illustration in Original]

220 North Dakota

220 North Dakota, which is considering amendments to its current reclamation law in this session of its legislature, reclaimed 153 acres in 1970. Using helicopters and hydroseeders to revegetate the land, state reclaimers planted twenty varieties of seed including 7,000 pounds of fertilizer and 16 species of shrubs and pines. To date operators have planted over half a million trees on disturbed land in North Dakota. In addition to their planting, operators and the state jointly stocked mined-land ponds with more than 6,000 trout, and other water life which maintains the fishes' food chain.

220 Ohio

220 The Buckeye State reported in with 5,972.7 acres of reclaimed land approved for 1970. Another 7,000 acres are already planted and awaiting approval next year. Of last year's total, 4,357.5 went to trees and 1,615.2 went to forage.

220 Oklahoma

220 Oklahoma, operating on a fiscal year, affected 1,306 acres with strip mining in 1970 and planted 1,427 - mostly to pasture. The state was able to

reclaim more than it mined because Oklahoma's law allows (as do some other states) operators to reclaim land disturbed before the law was passed and substitute it for land currently being mined. Ultimately the land currently being mined must be reclaimed also.

220 Pennsylvania

220 Coal operators in Pennsylvania applied for permits on 13,183 acres in 1970 but, as in other states, they did not necessarily get around to mining them all. Land planted in 1970 came to 9,089 acres with 5,837 going for trees and 3,252 for grasses.

220 [See Illustration in Original]

220 Tennessee

220 Tennessee's permit year ends later than other coal mining states and consequently its reclamation figures are not complete. Based on the information in at the end of January, 1971, state inspectors had approved 650 acres of reclaimed land.

220 Virginia

220 Virginia, which was responsible for producing 3,561,000 tons of strip coal in 1969, reclaimed 2,682.54 acres of land in 1970. The amount of land reclaimed corresponded to that disturbed during the same period. Reclaimers used 120,874 pounds of seed in 1970 and have sowed 107.72 tons of seed since their reclamation program took effect in 1966.

220 West Virginia

220 West Virginia was another state which saw a marked increase in surface mining, as evidenced by the 95 new companies which began operations there during 1970. Like Kentucky, the enforcement agency was not staffed to cope with the increased activities and consequently the Department of Reclamation hired six new inspectors last year.Those acres which were inspected and approved as properly reclaimed, came to 13,245.47.

{221} [From the Mining Congress Journal, June 1971]

221 RECLAMATION AT BIG HORN MINE

221 (By J. F. Rulli, Sales Manager, Big Horn Coal Co.)

221 Men and machines have scarred the earth; men and machines must restore it just like Mother Nature created it - maybe even better!

221 Primitive man, at the beginning, the same as now, had nothing but the earth from which to gain sustenance upon this planet. He gained his food, shelter and clothing from the surface of the earth or from the animals and fish that fed on the surface. At best his existence was very difficult. He had no knowledge of the treasures that the earth held below the surface; that in centuries to come, these treasures would bring him to the advanced civilization we now know.

221 Today there are many who see open coal mines, stone quarries, gravel pits, copper and iron mines, phosphate and lime quarries and start to scream about the land being ruined but who do not seem to look back a few centuries to the sad lot of man before our time.

221 The earth has been good and given both from the surface and the subsurface. It is a duty to continue to extract these treasures from the earth to maintain the present standard of civilization, but it is also a duty to restore the earth to its original state or to convert it to some real useful purpose.

221 BIG HORN BEGAN RECLAIMING LAND SEVEN YEARS AGO

221 To restore land to its original state is not always easy, but with good engineering and modern equipment, restoration can be accomplished as it is being done today at the Big Horn coal mine.

221 Big Horn Coal Co. has been conducting a conservation and restoration program at the site of its mining operation, eight miles northwest of Sheridan, Wyo., for a number of years. During the 27 years the firm has been operating, many acres of land have been changed in appearance as the natural terrain has been stripped aside to gain access to valuable seams of coal which are of vital need to the nation's domestic and industrial well-being. During the past seven years substantial areas of this acreage have been returned to the original, natural appearance thanks to Big Horn's management and its voluntary program of land restoration.

221 COMPANY STARTED STRIP MINING IN 1943

221 Big Horn began operations in 1943, and since that time, more than 17 million tons of Big Horn coal have been produced and marketed in the northwest area of the United States. Big Horn is a subsidiary of Peter Kiewit Sons Inc. of Omaha, Neb., which is one of the largest contracting organizations in the world. The Big Horn mine is a strip operation and is the lone survivor of seven

mines in Sheridan County. The last of the underground mines closed in 1953.

221 At Big Horn mine, it is very common to mine seams from 25 to 50 ft in thickness. There are, of course, advantages in strip mining. It permits efficient, lower cost removal of the overburden covering coal seams, and it has made possible the recovery of millions of tons of valuable coal that could not have been mined economically by any other method. Overburden in the area runs from 50 to 100 ft in thickness and it is, therefore, easy to visualize that, at times, there are pits at least 150 ft deep. Therefore, strip mining has opened the earth leaving scars both wide and deep.

221 VOLUNTARY LAND RESTORATION MAPPED IN EARLY 1960'S

221 In the early 1960's, Big Horn displayed a genuine interest in the natural beauty of the area and voluntarily began to map a program of land restoration. Sheridan County normally has only 15 to 16 in. of precipitation annually to promote vegetation and growth. Big Horn had to resort to fertilization, sprinkling and the use of native tree seedlings and imports that thrive under arid conditions in order to reclaim the strip-mined land.

Because of the thickness of seams mined, the amount of surface affected by strip mining is minimal. There has been very little pressure on the mine operators to return mined land to its original state. The fact that Big Horn voluntarily endeavored to reclaim and revegetate the disturbed surfaces, with sometimes very disappointing results, is to its credit.

{222} WYOMING ENACTED OPEN CUT LAND RECLAMATION ACT

222 It was not until May 24, 1969 that the Wyoming State Legislature made effective the Open Cut Land Reclamation Act.Some of the pertinent points of the law are as follows:

222 (1) A permit is required to open a strip mine; a $5 0 fee is charged for the permit and there is a $1,000 fine for failure to comply.

222 (2) Legal description of the land to be mined is required.

222 (3) An estimate of the volume of earth to be removed is required.

222 (4) Spoil piles must be graded to reduce peaks and ridges to a rolling topography.

222 (5) Material that could generate acid must be covered with other soil to correct the acidity.

222 (6) Revegetation of the pile is very much encouraged.

222 (7) Lakes and ponds should be provided wherever possible.

222 Big Horn started its program of revegetation in 1960 and, at that time, followed the requirements which are now in the Wyoming law.

222 TOPSOIL IS THIN

222 Water in the mining areas has not been a problem as it is almost clear of acid, and coal beds are low in sulfur content. Water entering either active or abandoned pits is mostly ground water that continues to flow and does not become stagnant or acidic. Water which is impounded in worked-out areas is considered an asset. To revegetate the land, topsoil is essential, and in the Big Horn mine area, this is a problem as the topsoil is thin, running from two to six inches.

222 Overburden at the mine was removed by scrapers and, in some cases, the topsoil was salvaged. During backfilling, putting the soil back in its original state was tried; however, in some instances it was impossible to do this, and naturally the reclaimed spoil material had to be allowed to weather for one or two years so that it could develop a surface that would permit germination of seed and good rooting for seedlings.

222 FIRST RECLAMATION PROJECT WAS IN 1964

222 The very first reclamation project was in 1964 when revegetation was started on one of the Plachek tract plots adjacent to a hill in which the upper beds had been burned out by ancient fires so that the red scoria, or burnt rock, was exposed on the hillside. The plot, which was sloped gently to the edge of Goose Creek (it had been relocated), was planted with a mixture of clover and sudan grass, and seedlings of cottonwood, chokecherry, native plum and Ponderosa pine. This first planting was successful insofar as grass germination was concerned, but there was a high percentage of failure in seedling growth. A better supply of rainfall had been expected; however, the rains did not come and no provision had been made as yet for a sprinkling system; therefore, the seedlings did not do too well.

222 THE 1968 PLANTING HAD BETTER RESULTS WITH A SPRINKLING SYSTEM

222 In 1968 another Plachek plot on the opposite side of Goose Creek was planted. Fertilizer was spread over the entire surface and a sprinkling system

was used. Water was pumped from Goose Creek through an 8-in. aluminum line reduced to 4-in. aluminum lines equipped with sprinkler heads at 40- to 45-ft intervals. This area was planted in oats mixed with pasture-mix seeds. Caragana and Russian olive seedlings, both partial to arid climatic conditions also were included in the planting. Grass germination was good, except that some of the spots on the slopes which did not have the surface weathered properly for seed germination were still bare two years later. All the varieties of seedlings had a high percentage of recovery, a fact attributed to the generous applications of water by the sprinkling system.

222 In 1968, shallow contour ditches were introduced on certain sloped areas. These provided moisture catch basins for the seedlings planted on the downhill side of the ditches. They also reduced slope erosion. In the area, it is common to have hardly any precipitation from the middle of June to September 1; therefore, it was necessary to install a permanent sprinkling system. This materially aided the program.

{223} 1970 PLANTING IS APPARENTLY SUCCESSFUL

223 In the spring of 1970, a spoil bank adjacent to the present Zowada pit was sown in rye grain. Several months later the rye stalks were waist high, and coverage on the generally flat-topped surface was good. The rye grain, it is believed, will provide good mulch for the bank surface and permit planting of seedlings at a later date with greater assurance of good rooting.

223 ABANDONED PITS CONVERTED TO LAKES PROVIDE RECREATION

223 Restoration didn't stop there. Big Horn converted other abandoned mine pits into beautiful small lakes and ponds, some with depths ranging to 70 ft.With the cooperation of the Wyoming Game and Fish Department, 2500 rainbow trout were planted in a larger lake, and smaller ponds were stocked with channel catfish, bass, crappie, and yellow perch. Not only has the natural habitat been restored, but something new has been added - fishing, boating and other forms of recreation. In other words, recreational advantages which were not there before are now available to the public. As a matter of fact, the Wyoming Recreational Department has designated some of the sites to be made into recreational areas for the many people touring Big Horn's part of the state as well as for the local people. The area has already been mapped and the plan soon will become reality. The new grass and tree growth is providing cover and food for fowl and game, and population increases in pheasants, partridge and ducks have been noted. Men have learned to scar the earth, but they've also learned to heal the wound.

223 [From the Washington Daily News, June 30, 1971]

223 RAVAGED LAND: HIGH PRICE FOR CHEAP COAL - PENNSYLVANIA HAS A DEDICATED MAN TO ENFORCE STRIP MINING LAW

223 (By William Steif)

223 HARMONY, PA. - Bill Guckert, 63, bald and sweating, stands on a little rise at the edge of a farm here, 30 miles north of Pittsburgh.

223 Several hundred yards away, Pittsburghers' summer cabins line a pleasant creek.Dogwoods and apple trees are finishing their bloom and the hardwoods along the creek are cloaked in splendid spring greens.

223 "This acreage was strip mined right to the summer cottages two years ago. The first year, the mine operators put in wheat; now they've got clover in. That's the Deep Valley golf course just up the road. You'd never know these 75 acres were a strip mine, would you?" said Mr. Guckert.

223 Mr. Guckert is paid $1 7,000 a year to be the state's director of the Bituminous Bureau of Conservation and Reclamation in its department of environmental resources.

223 His job is to make sure the 325 licensed strip mine operators in Pennsylvania carry out provisions of the best and earliest strip mine reclamation law in the nation. The law was enacted in 1963 after a campaign spearheaded by the Pittsburgh Press, a Scripps-Howard newpaper.

223 Mr. Guckert is a taxidermist by profession.

223 STRIPPER LICENSE

223 He is tough. He does not hesitate to suspend a stripper's license, tying up the strippers' expensive machines and manpower. He prefers that to prosecution as a way to get compliance with the law.

223 A 12-hour day doesn't faze Mr. Guckert.He has one overwhelming passion: To see that the strippers restore the land.

223 "The idea," he says, "is to let industry do it, not the taxpayers. Industry can do it for a fourth of what the taxpayers can do it for. Before our 1963 strip mining law was enacted the state government had to reclaim stripped land and the taxpayers were being gouged to pay for the restoration."

223 Under Pennsylvania's 1963 law the strip mine operator is required to:

223 Put up a bond of $5 00 to $1,000 an acre, with a minimum bond of $5,000, to guarantee reclamation performance.

224 File a pre-mining plan detailing how the land will be restored.

224 Put the land back to its approximate original contour or, if the grade was steeper than 12 degrees, terrace it.

224 Ask the impartial state land reclamation board for variances on the rules.

224 Fill in land where coal already has been removed while other parts of the seam are still being removed.

224 Be sure that acid-bearing minerals are covered, and that grass, clover, wheat, trees or a mixture of these are planted.

224 STRIP SCARS REMAIN

224 Recently, Mr. Guckert drove me 325 miles around western Pennsylvania. I saw more than 40 past and present coal strip mines. In a few cases, strip scars remained, mostly from mining that took place before Pennsylvania passed its 1963 law. But in dozens of other cases, the land was restored to natural grades, vegetation was growing on it, and in some spots cows were grazing.

224 "No one knows when I'm coming," Mr. Guckert says. "I don't sit on the seat of my pants in Harrisburg like some of those fakers. My inspectors (who earn $9,375 to $1 3,000 a year) take a 16-week course; then they have to pass a civil service exam."

224 Mr. Guckert now expects the state legislature to expand the coal strip law to all surface mines. Passing a U.S. steel limestone pit west of New Castle, Pa., he says scornfully: "That look like the badlands of South Dakota."

224 Near Grove City, Pa., Mr. Guckert points from the highway at tangled, swampy, useless acreage and says: "That's where the Buckeye Coal Co. - a subsidiary of Youngstown Sheet and Tube - did its dirty work years ago."

224 Mr. Guckert forces the strippers to post signs on every job with full details of their work. "The public has a right to know this," he says.

224 GREW FROM A LIE

224 Pennsylvania's tough law and tougher enforcement grew from a lie.

224 Fred Jones, a veteran Pittsburgh Press reporter, recalls: "Our original 1947 law required only that the stripper cover the exposed coal seam. That meant he just had to knock the top of the spoil bank into the pit."

224 In 1961, the state's sportsmen groups, in which Mr. Guckert was an officer, had a bill introduced for more complete restoration, Mr. Jones says:

224 "Just before the vote, a beautiful, full-color brochure appeared on the desks of every legislator. It was entitled "The Restoration of Pine Creek' and purported to tell how strip miners had restored a trout stream."

224 The strip proposal was beaten.

224 Mr. Guckert and I tried to find Pine Creek, Mr. Jones asys. "We couldn't find it anywhere in the area it was supposed to be."

224 One day they stopped at a country store and asked about the creek. The storekeeper replied: "Only pine creek I know is that ditch you passed."

224 Mr. Jones recalls: "It looked like hell." The brochure the strip mine lobbyists gave the legislators contained photos of a lovely trout stream - but it wasn't Pine Creek. The pine trees pictured were on the state university's experimental plantation.

224 THREATENED REPRISALS

224 The Press printed its findings on a Sunday. The strippers threatened reprisals. Mr. Guckert's sportsmen picked out eight state legislators, including the speaker of the House and a powerful committee chairman, for political extinction. Two years later, with the eight gone from the legislature, the tough strip mine bill passed.

224 Russell Haller, 48, is a Kittanning, Pa., strip miner whose company produces 150,000 to 200,000 tons yearly.

224 "I fought Bill Guckert and his conservation group as hard as any man alive," he recalls. "I said we couldn't comply, that the 1963 law would put me out of business.

224 "I was Mr. Guckert's worst enemy. I hated him. We almost came to blows."

224 Mr. Haller suffered losses. Because of the new law's stringency he had

to give up leases on some coal lands on which he had paid advance royalties. He says that in 1963 there were more than 500 strippers in Pennsylvania, that their number dropped to 270 last year, and that only the booming coal market has brought more strippers back to the field.

{225} Mr. Haller scoffs at "those characters in Ohio and West Virginia who have the politicians so buffaloed they get away with horrible high walls." He says; "The secret in Pennsylvania is proper, uniform enforcement. Mr. Guckert treats us all alike, big or small." Other strippers in Pennsylvania agree.

225 IN A HELICOPTER

225 Whirl above West Virginia in a helicopter with Gilbert Frederick and Fil Nutter, of Charleston, whose strip operations produce more than three million tons of coal yearly.

225 They complain of a hostile press and of West Virginia's Secretary of State John D. Rockefeller IV, who favors a strip mine ban.

225 Mr. Frederick and Mr. Nutter belong to the state's Surface Mining Association, which has 80 members and produces two-thirds of the 28 million tons stripped yearly from the state's hills.

225 Twenty-three states today have some kind of strip-control law on their books. But the strippers' zeal in removing the coal has sparked a growing demand to ban all stripping.

225 West Virginia's legislature narrowly beat a strip ban this spring, and Jay Rockefeller and his allies will seek the ban again. Similar legislation is almost sure to come up in Kentucky, and may pop up in Ohio, too.

225 President Nixon wants to give the states two years to legislate strict reclamation rules, based on federal standards, and then wants the Interior Department to take over regulation if the states don't go along.

225 [From the Baltimore Sun, April 15, 1971]

225 WHAT THE ADVERTISING DOESN'T TELL

225 (By Ernest B. Furgurson)

225 JENKINS, KY. - You may remember the ad: a full page in color in Time, Newsweek and elsewhere. A happy youngster in jeans and baseball cap fishing with his grandpa beside a blue mountain lake.The grandpa tells how he feared

when strip mining first opened that hole in the earth that "these old hills have had it," but now he's glad because it created such a nice 43-acre fishing hole.

225 To his testimony, Bethlehem Steel added: "We need lots of coal, and we must mine it where it is . . . even if this sometimes means disturbing the natural terrain of hillsides and mountain slopes. But the disturbance is only temporary. Every acre of land surface mined by Bethlehem is promptly and effectively restored . . . often to more beneficial use than before it was mined."

225 The ad made strip mining seem such a public-spirited and beautifying enterprise that I just had to come down to have a look at Fishpond Lake. And it turned out to be true, from one point of view. If you circle the lake carefully, you can find a narrow angle from which, when the light is right, the proper filters are used and the background forest is at season's peak, it all looks like a cameo from a Sierra Club publication.

225 But don't look left or right. What you see there is characteristic of all strip mines: coal slides into the water, scars in the mountainside.Fishermen were there in the Easter weekend sunshine, and so were beer cans and gritty dust blowing from the irreparable gash in the slope opposite.

225 The main thing Bethlehem contributed toward Fishpond Lake was the land after it had been ravaged. The state of Kentucky built the dam and lake. Student architects from Yale did the pier. Workers in an OEO program provided much of the labor. Then Bethlehem ran the ad, which quite likely cost many times what the land itself was worth.

225 One eastern Kentuckian who happens not to be a Bethlehem employee says that all Fishpond Lake proves is that if you want to spend half a million dollars you can make a pond out of a stripped hollow. But you can't do it with every stripped hollow; this one just happens to be on a high plateau near where several rivers originate. And it was torn out by relatively small equipment more than a decade ago, before the giant landeaters were built which now are ripping up thousands and thousands of acres of West Virginia, Pennsylvania, Virginia, Ohio, Kentucky, Maryland and other states.

225 Of course neither Bethlehem nor any of the other absentee companies financing this frenzy of strip mining during the current period of high coal demand is about to spend half a million dollars reclaiming each hole they claw in the earth. The pattern is for them to fight desperately in the state legislatures against laws which require them to replant forest and otherwise

go through the motions of reclamation.

{226} Even where such laws are in effect, they are no more than a gesture, It simply is impossible to put a mountain back together after it has been torn apart. What happens instead has been well publicized - the mud slides that often inundate the homes of the people who own the land but unfortunately not the mineral rights beneath the surface; the acid runoff that kills the streams; the desolate moonscape that offends the eye from an airplane overhead or from the roadside parking areas that once offered views of peaceful hills beyond hills.

226 One such pulloff is in Pound Gap, where U.S. 23 crosses from Virginia into Kentucky. The highway overlooks Jenkins, surrounded by mountains whose sides are shorn away, making long brown scars where trees would be budding if they still grew. This is the domain of Bethlehem Steel, which owns the land, usually contracts the stripping, then buys back the coal.

226 Not far from Fishpond Lake is the Millstone strip mine, on which Bethlehem spent many thousands as a reclamation demonstration project. Little grows there but weeds.

226 There is an outcry about stripping in every state where it is practiced. Laws are passed, but they are mere wrist-slapping. There is debate over banning stripping entirely. But there is no way it can be halted immediately. The companies are fighting a ban while the acreage stripped multiplies each year. Even road builders and specially formed speculation firms are rushing to get theirs by strip mining while the market is hot.

226 Meanwhile, the effort is made to soothe the body politic with full-page ads in national magazines, read mostly by people who will never have a chance to take a first-hand look at Fishpond Lake or the rest of the misused land. And it should be added that what the strippers do to try to assuage public opinion is duplicated by other industries. Lumber, for one.

226 [From Life, Oct. 1, 1971]

226 TAMING THE STRIP-MINE MONSTER

226 (By Edmund Faltermayer)

226 I have long loathed the very idea of strip mining. When men tear open the land to a depth of a hundred feet or more to get at a seam of coal and then abandon the site in a naked condition, the devastation can take millennia to heal. Nearby streams become murky with silt and toxic with acid. The huge, ugly spoil banks - the rocky material dumped to the side to expose the coal - support little vegetative cover and are prone to landslides. And when machines chew into the side of a mountain they leave steep "highwalls," or manmade

cliffs, on the uphill side of the cut. Not long ago I saw hundreds of miles of these cliffs that have been slashed across the slopes of Appalachia, and it was a sickening sight.

226 Spurred by the shortage of coal for generating electricity, strip mining is expanding at a fearsome rate and now produces 40% of the nation's coal. Angry voices are calling for a halt to the practice. In West Virgina, young John D. Rockefeller IV, running for governor, demands that stripping be outlawed in his state "completely and forever." Another West Virginian, Representative Ken Hechler, has 90 cosponsors for his bill in the U.S. Congress to outlaw it nationwide. Abolition is the only solution, argues Hechler, because the various state laws requiring companies to restore strip-mined sites are weak, or have been sabotaged by lax enforcement. Furthermore, say the abolitionists, good reclamation - assuming companies could be compelled to do it - is so costly that it would wipe out the economic advantages of strip mining.

226 Yet the consequences of a total ban on strip mining - which would mean more reliance on nuclear power, and sending more down to underground mines - are pretty unattractive too. Besides, the abolitionists haven't made a case that good reclamation of strip mines is prohibitively expensive. It costs $1 .50 a ton less, on the average, to strip coal than to send men into the bowels of the earth for it. That cost advantage is so great that strip-mining companies can afford to do some pretty fancy regrooming if they are made to do it. I know this is so, because I've been to Pennsylvania, a state which rigorously enforces its reclamation law, the toughest in the land. A lot of Pennsylvania companies are now going beyond what the law requires - replacing topsoil, for example. "They've really got religion on reclamation now," says William E. Guckert, who run the state's enforcement program. "But," he quickly adds, "they didn't get religion until we put the screws to them."

{227} Cynics will greet with disbelief the news that there is a state government anywhere that puts the screws to the strip-mining industry. How it happened is worth telling. With more scarred acreage than any other state, Pennsylvania also has the country's biggest constituency of outdoorsmen to notice all the ruined terrain - 1.1 million licensed hunters and 800,000 fishermen - and they know how to lobby. Pennsylvania also has Bill Guckert, a powerhouse of a man at 63 who got into the strip-mine fight in the 1950s.

227 The outdoorsmen fought hard to get a tough law on the books, Guckert recalls, and when some legislators sat on the bill "we beat the living H out of them" at the polls. A good law finally passed in 1963, and Guckert took over the enforcement agency four years later. Almost immediately, he was pressured by a political boss to go easy on a strip miner who was violating the rules.

But Guckert, who had the full backing of then Governor Raymond Shafer (as well as his successor, Milton Shapp), angrily refused. From that day, he says, he has operated without political interference.

227 In the four years that Guckert and his 20 inspectors have been riding herd on 360 bituminous strip-mine operators, the results have begun to show. At 16 different locations I saw the land completely "backfilled" by law to approximately its original contours. This means that all the material in spoil banks has been bulldozed back into the deep trenches where the coal lay, in a manner that completely buries those ugly "highwalls." In Pennsylvania they not only backfill completely, but do it promptly, in order to minimize the exposure of acid-forming strata to air and water. Even temporary water pollution is prohibited. Water that collects while mining is under way must be treated in settlement basins.

227 We came to Emerson Bowser's farm in Jefferson County. His rolling cropland was literally turned upside down for coal - with vast spoil banks and 80-foot high-walls at one point - but today you'd never know it.Tall corn grows in the replaced topsoil, and the fertility is coming back. In five years, says Bowser, "there won't be any difference" in his crop yields.

227 Pennsylvania in fact is getting an extra dividend from its law: vast tracts of land damaged in bygone days, when laws were lenient, are being restored. With today's bigger machines, companies can return to formerly strip-mined sites to work seams that were too deep to be stripped profitably in the past; and when they do, they must put the whole thing back together. In a mountainous area near Clearfield, in the center of the state, the improvement is breathtaking. On one side you can see an "active" site with spoil banks and highwalls from the past, newly churned up for deeper coal - a lunar landscape if there ever was one. On the other side the land is regraded and planted as far as the eye can see. Companies returning to old sites are restoring "thousands of acres at no cost to the taxpayer," Guckert says. That is why he doesn't want to ban all strip mining now, for then the state itself would have to restore these "orphan" lands at enormous cost.

227 In the early 1960s, when trying to prevent passage of the Pennsylvania law, strip-mine companies warned that the cost of elaborate reclamation would put them out of business. As it turns out, strip-mine production of soft coal has increased somewhat under the new law, and reclamation adds an amazingly low 15~~~ to the average cost of getting a ton of coal out of the ground.

227 The foes of strip mining take little comfort from the Pennsylvania experience, which to them comes from a unique combination of broad public concern and honest enforcement. Meanwhile, they say, the damage goes on.

Stripping is just getting under way on a large scale in such western states as Montana, Idaho and Wyoming. To appreciate the freebooting atmosphere that still prevails in most states, cross from Pennsylvania into Ohio as I recently did. There, under a reclamation law that is an insult to the intelligence of that state's citizenry, companies are leaving sheer vertical highwalls, some of them 150 feet high and close to busy roads.

227 Obviously something has to be done, and quickly. Pennsylvania's reclamation standards, which may soon be tightened further, should become the minimum for the whole nation. The Nixon administration has proposed that Congress set federal standards for reclamation, to be applied within two years if states don't enact sufficiently strong rules in the meantime. But the states should not need a prod from Washington. Public indignation is rising, and a whole new industry is, in a sense, on trial for its life.

{228} [From Montana Law Review, Winter 1971]

SELECTED READINGS

RECLAMATION

STRIP-MINING RECLAMATION REQUIREMENTS IN MONTANA - A CRITIQUE

228 I seek acquaintance with Nature, - to know her moods and manners. Primitive nature is the most interesting to me. I take infinite pains to know all the phenomena of spring, for instance, thinking that I have here the entire poem, and then, to my chagrin, I learn that it is but an imperfect copy that I possess and have read, that my ancestors have torn out many of the first leaves and grandest passages, and mutilated it in many places. I should not like to think that some demigod had come before me and picked out some of the best of the stars. I wish to know an entire heaven and an entire earth. n1 - Henry David Thoreau, March 23, 1856

228 n1 E. PORTER, "IN WILDNESS IS THE PRESERVATION OF THE WORLD" 56 (1967).

228 I. INTRODUCTION

228 While the present clamor over environmental issues continues, most public attention has been focused on pollution problems concerning air and water. Little concern has been expressed over the ravaged land resulting from industrial use, except in those states burdened with emasculated landscapes. Eastern Montana is a potential strip-miner's paradise; hence, the problem of restoration can no longer be ignored and has, in recent months, become a major political issue. The state legislature has been concerned with this issue during the last two sessions, yet minimal effective progress has been made in

providing adequate reclamation requirements. In order to determine what measures are necessary to reclaim spoiled land areas, consideration must be given to the detrimental effects from the stripping operation, present legal requirements for restoration, the practical implementation of reclamation procedures, and the need, if any, for more stringent regulation of the reclamation process.

228 Coal strip-mining involves removing layers of soil overlying the coal seam and is thus a more economical means of extracting coal from shallow beds than subsurface mining. n2 Two methods are usually employed depending on the topography of the area to be stripped. n3 On relatively flat terrain, area stripping is utilized. Initially, a cut is made across the area to be mined in the form of a long trench; the overburden is removed by explosives and excavating machines. As each successive cut is made, the spoil is dumped in

the previous cut. The final cut is generally left open to fill with water. The result, unless graded, is a series of spoil banks which resemble the ridges of a washboard. n4

228 n2 U.S. DEP'T. OF INTERIOR, SURFACE MINING AND OUR ENVIRONMENT 33
(1967); Note, Local Zoning of Strip Mining, 57 Ky.L.J. 740 (1969).

228 n3 R. Donley, Some Observations on the Law of the Strip-Mining of Coal, 11 ROCKY MT. MINERAL L. INST. 124, 125 (1966); ENVIRONMENT, supra note 2 at 34.

228 n4 Id.

228 On a hilly or mountainous terrain, contour stripping is employed. The overburden removed is deposited at the outer edge of the cut. More cuts are then made along the hillside. The visual effect is a bench along a hill, bordered on one side by a high wall and on the other by a rim of deposited overburden which forms a slope down the hillside. n5

228 n5 Id.

228 The mining operation usually contains four stages: clearing the site to be mined, removing the overburden, extracting the coal and transporting it to market. n6 For effective reclamation, it is necessary to integrate reclamation procedures into these various stages.

228 n6 ENVIRONMENT, supra note 2 at 37.

228 In 1967 the Department of the Interior reported that in the United States, prior to 1965, approximately 3.2 million acres of land n7 had been disturbed by surface mining. n8 Coal mining accounted for 41 percent of the total acreage disturbed. n9 As of January 1, 1965, 26,000 acres in Montana had been affected by surface mining, 19,600 of which remained unreclaimed. n10 During the same period, strip mining of coal affected only 1,500 acres of the aforementioned total, n11 but it is estimated that 3.1 million acres of land in eastern Montana contain coal deposits extractable by the stripping method. n12 On the basis of these figures it is apparent that Montana's coal potential has barely been tapped. The statistics also indicate that little reclamation has been achieved in Montana. With the probability of an increase in coal production, the necessity of reclamation requirements is even greater.

228 n7 Id. at 39. This figure included only excavation and areas required to dispose of spoil or waste from mining operations. An additional 320,000 acres were affected by access roads and exploration a activities.

228 n8 The term "surface mining" does not refer to coal strip-mining alone; it includes other fuels and minerals extracted by removing overlying strata, e.g., sand, gravel, phosphate, marble, gold and copper.

228 n9 ENVIRONMENT, supra note 2 at 39.

228 n10 Id. at 111, app. I, table 2.

228 n11 Id. at 110, app. I, table 1.

228 n12 1969 GOVERNOR'S CONFERENCE ON MINED LAND RECLAMATION AND MONTANA MINING LAW, PROCEEDINGS AND RECOMMENDATIONS 37 (JUNE 1970).

{229} II. ENVIRONMENTAL EFFECTS

229 Strip mining disrupts the balanced ecosystem in four general ways: (1) pollution of air, (2) pollution of water, (3) disruption of soil cover and vegetation growing thereon, and (4) destruction of the aesthetic value of the landscape. n13

229 n13 ENVIRONMENT, supra note 2 at 56; E. Clyde, Legal Problems Imposed by Requirements of Restoration and Beautification of Mining Properties, 13 ROCKY MT. MINERAL L. INST. 191, 211 (1967).

229 The contribution of coal strip-mining to air pollution is relatively slight. Dust which is activated by digging and hauling overburden and smoke

from any combustion occurring when the coal is exposed to air is minimal and provide irritants which are more annoying than toxic. n14

229 n14 ENVIRONMENT, supra note 2 at 56, 68; C. Boley & W. Kube, Western Coals: Some Trends in Utilization and Research, WESTERN RESOURCES PAPERS 195
(Vol. 8, 1966).

229 Water, however, is highly affected by the stripping operation. In removing overburden, certain sulphur-bearing minerals are exposed. n15 While Montana's lignite deposits are generally low in sulphur content, the sulphur factor increases in other types of coal. n16 When exposed to air and water, these sulphur-bearing minerals oxidize, forming sulfuric acid which may enter streams via surface runoff or ground water. Streams with high-acidity in turn upset the balance of animal life and vegetation in the area dependent on the water source. n17 The exposure of acidic minerals also poses problems in later attempts to revegetate spoil banks. n18

229 n15 ENVIRONMENT, supra note 2 at 56, 63. Legal Problems, supra note 13 at 199.

229 n16 Sulphur content of U.S. coals varies from 0.2 percent to 7.0 percent. Approximately 69 percent of the Montana deposits contain 0.7 percent or less of sulphur. Western Kentucky coals average about 3 percent sulphur or more while 91 percent of West Virginia's reserves have a sulphur content of 3 percent or less. U.S. BUREAU OF MINES, DEP'T. OF INTERIOR, CIRCULAR NO. 8312,
SULPHUR CONTENT OF UNITED STATES COALS 1, 3, 4 (1966).

229 n17 ENVIRONMENT, supra note 2 at 63.

229 n18 Observations, supra note 3 at 127.

229 Since the topsoil and vegetative cover is stripped from the mined area and left in conglomerated heaps, resulting spoil banks and stripped land areas lack the protective timber and other plant growth which regulates surface runoff. Consequently, the area loses most of its immunity to erosion from water and wind. In areas of high precipitation, the sediment yield increases, clogging streams and endangering the area by possible landslides. n19

229 n19 ENVIRONMENT, supra note 17.

229 Research conducted in Kentucky indicated that [sediment] yields from coal strip-mined lands can be as much as 1,000 times that of undisturbed forest.

During a four-year period, the annual average [sediment yield] from Kentucky spoil banks was 27,000 tons per square mile while it was estimated at only 25 tons per square mile from forested areas. n20

229 n20 Id.

229 Although erosion is directly related to the amount of precipitation, these problems will still exist to some degree in semi-arid regions. n21

229 n21 "At some idle surface mines in arid country, the effects of wind and water erosion are still evident on steep spoil banks that were abandoned many years ago." ENVIRONMENT, supra note 2 at 63.

229 Perhaps the most obvious detriment caused by coal strip-mining is the destruction of the natural landscape, leaving instead eyesores of spoil banks, open cuts and access roads. As the timber and other plant life thriving on the topsoil is cleared in preparation for mining, wildlife dependent on the area for its habitat and food supply are also displaced. The aesthetic beauty of the surrounding landscape is diminished by the despoilation of one small area. n22 It is probably the aesthetic quality more than any other factor that brings the reclamation problem to public attention. After decades of watching scenic areas disappear beneath the giant teeth of industry, many states belatedly recognized that abatement of barren landscapes could only be accomplished by placing specific obligations on industry to restore what they have disrupted. The advancement of legislation oriented to solving environmental problems has been slow, but in some states controls have been strengthened by creating centralized administration of the reclamation process, penalizing operators who fail to reclaim and specifying reclamation requirements.

229 n22 Proceedings of the White House Conference on Natural Beauty, Beauty for America, ch. 12 (1965); ENVIRONMENT, supra note 2 at 52, 56, 63; The Missoulian, Nov. 19, 1970 at 11, col. 1.

{230} III. PRESENT RECLAMATION REQUIREMENTS - COMPARISONS

230 Reclamation legislation falls into two categories: basic reclamation emphasizes preventive measures which will reduce the detrimental side-effects of strip mining, such as erosion and pollution; rehabilitation extends the basic reclamation process further to restore the stripped area to some productive use, such as recreational areas, agriculture use or wildlife refuges. n23 In prelude to the following analysis of the basic provisions in some states, it should be noted that the legislation of Kentucky and West Virginia are generally concerned with basic reclamation while Montana, Wyoming and North Dakota appear to speak to rehabilitative programs. n24

230 n23 ENVIRONMENT, supra note 2 at 81.

230 n24 Compare KENTUCKY REVISED STATUTES @ 350.202 (1969) [hereinafter cited as KRS] and WEST VIRGINIA CODE @ 20-6-1 (Cum.Supp. 1970) (hereinafter cited as W.VA. CODE] with WYOMING STATUTES @ 30-96.4 (1957) (Supp. 1969) [hereinafter cited as W.S. 1957]; NORTH DAKOTA CENTURY CODE @ 38-14-01 (Supp.

1969) [hereinafter cited as ND]; and REVISED CODES OF MONTANA @@ 50-1001,-1005
(1947) (Supp. 1970) [hereinafter cited as R.C.M. 1947].

230 A. Kentucky and West Virigina

230 Since Kentucky and West Virginia rank among the top coal-producing states in the nation, n25 their legislation has formed a basis on which other states have built their restoration programs. By 1965, the acreage disturbed by the strip-mining of coal in Kentucky totaled 119,200 while in West Virginia, 192,000 acres had been affected. n26 Both states have created a Division of Reclamation within their respective Departments of Natural Resources to administer the reclamation of stripmined lands. n27 An operator must obtain a permit to mine in either state, n28 which is conditioned upon submission of reclamation plans with the application for the permit n29 in addition to payment of fees and performance bonds. n30 The fees and bonds are deposited in a special reclamation fund. n31

230 n25 Observations, supra note 3 at 123, 124; ENVIRONMENT supra note 2 at 115, app. I, table 11.

230 n26 ENVIRONMENT, supra note 2 at 110, app. I, table 1.

230 n27 KRS @ 350.050; W.VA. CODE @ 20-6-3.

230 n28 KRS @ 350.060(1); W.VA. Code @ 20-6-8.

230 n29 @@ 350.060(6), 350.090; W.VA. CODE @ 20-6-9.

230 n30 @ 350.060(7); W.VA. CODE @@ 20-6-8, 20-6-16.

230 n31 KRS @ 350.140; W.VA. CODE @ 20-6-8.

230 In Kentucky, the application fee is fifty dollars plus twenty-five dollars per acre disturbed; n32 the performance bond ranges from one hundred to five hundred dollars per acre, with a minimum bond of two thousand dollars. n33 West Virginia requires an initial application fee of one hundred dollars which

is reduced to fifty dollars on renewal n34 plus a performance bond similar to Kentucky's with a minimum of three thousand dollars. n35 In both states the Division has the discretion to deny an application to strip mine in an area which in its judgment could not be properly reclaimed or may prove a hazard to public health or the aesthetic value of the landscape. n36 $

230 n32 KRS @ 350.060(7).

230 n33 Id. which states in part: In determining the amount of the bond within the above limits, the commission shall take into consideration the character and nature of the overburden, the future suitable use of the land involved and the cost of backfilling, grading and reclamation to be required. In a particular instance where the circumstances are such as to warrant an exception, the Commission, in its discretion, may reduce the amount of the bond for a particular operation to less than the required minimum.

230 n34 W.VA. CODE @ 20-6-8.

230 n35 Id. @ 20-6-16.

230 n36 KRS @ 350.085; W.VA. CODE @ 20-6-11.

230 Mandatory reclamation procedures include covering the exposed coal seam with four feet of non-toxic material, sealing off acid water, burying all acidproducing and other toxic materials, and preventing or treating surface runoff. n37 According to the method of strip-mining utilized, certain techniques of backfilling and grading are required n38 followed by revegetation in conformance with the proposed reclamation plan. n39 Revegetation may be deferred if investigation proves that the soil is presently unsuitable for planting. n40 After each stage of reclamation, that is, backfilling, grading and providing vegetative cover, a portion of the bond set aside for that stage is refunded. n41 Reclamation of the stripped area must generally be completed within one year after expiration of the permit. n42

230 n37 KRS @ 350.090; W.VA. CODE @ 20-6-14.

230 n38 W.VA. CODE @ 20-6-13; KRS @ 350.093 which states in part: (1) On lands where the method of operation does not produce a bench (area strip mining), complete backfilling shall be required, beginning at or beyond the top of the highwall and sloped to the toe of the spoil bank at a maximum angle not to exceed the approximate original contour of the land with no depressions to accumulate water. Such backfilling shall eliminate all highwalls and spoil peaks. Whenever directed by the division, the operator shall construct in the final grading, such diversion ditches or terraces as will control the water

runoff on long uninterrupted slopes. Additional restoration work may be required by the division according to regulations adopted by the commission. (2) On lands where the method of operation produces a bench (contour strip mining), terrace backfilling shall be required and performed as follows:

230 (a) All highwalls must be reduced or backfilled. The steepest slope of the reduced or backfilled highwall and of the outer slope of the fill bench shall be no greater than forty-five degrees from the horizontal; provided however, if the highwall is composed of solid rock and sufficient soil is not available to backfill or cover the solid rock suitable to establish vegetative cover, the commission, by regulation, may make modifications to the requirements of this section;

230 (b) The table portion of the restored area shall be a terrace with a slope toward the reduced highwall of not greater than ten degrees;

230 (c) The restored area shall have a minimum depth of four feet of fill over the pit from which the coal has been removed;

230 (d) There shall be no depressions to accumulate water but lateral drainage ditches connecting to natural or constructed waterways shall be constructed whenever directed by the division. The requirements in West Virginia are substantially the same.

230 n39 KRS @ 350.095; W.VA. CODE @ 20-6-10.

230 n40 KRS @ 350.100(2); W.VA. CODE @ 20-6-15.

230 n41 KRS @@ 350.093(6), 350.110; W.VA. CODE @@ 20-6-10, 20-6-15.

230 n42 KRS @ 350.100(1); W.VA. CODE @ 20-6-12. Failure to comply with reclamation requirements within the designated time limits results in revocation of the permit and forfeiture of the bond. No subsequent permit will be issued until the operator who forfeited has paid the bond amount as well as any additional sum deemed necessary to adequately reclaim the area. KRS @ 350.130; W.VA. CODE @@ 20-6-25, 20-6-8.

{231} Provisions have been made in both states with regard to reclamation of those lands mined prior to the enactment of restoration requirements. In Kentucky, the state may acquire those "orphaned land areas" which operators have left bereft and reclaim them with state and federal funds. n43 However, no land may be acquired to which a bond is attached, n44 thus it is necessary for a bond to be forfeited on land presently mined and not restored before the state may intervene and reclaim. West Virginia has a unique approach to this problem.

Instead of placing the burden on taxpayers to reclaim orphaned land, it requires all operators to pay a special reclamation fee of thirty dollars per acre before they may engage in strip-mining, n45 these monies are applied solely to the reclamation and rehabilitation of derelict lands by the director of natural resources. n46

231 n43 @@ 350.152, 350.153.

231 n44 Id. @ 350.158.

231 n45 W.VA. CODE @ 20-6-17.

231 n46 Id.

231 The requirements of Kentucky and West Virginia reveal a trend in those states where strip-mining is a major industry to leave less of the determination of reclamation procedures to the discretion of the mine operators. Both states insist on the commencement of the reclamation process before the mining operation has ceased; backfilling and grading, for instance, are required to be completed within specified time limits before the machinery is removed from the stripped area. n47 This not only insures the completion of these processes but reduces the cost to the speaker. n48

231 n47 KRS @ 350.093(4); W.VA. CODE @ 20-6-10.

231 n48 ENVIRONMENT, supra note 2 at 37, 39.

231 Since contour stripping is the primary method of coal strip-mining in these states, n49 many opponents of more stringent relamation laws discount comparisons of reclamation problems in the Appalachian regions with portents of what may occur in regions where area stripping is employed and strip-mining of coal is minimal as in Montana. However, it is neither necessary not practical to await development of erosion and pollution problems, regardless of the method of mining utilized, before instituting basic reclamation procedures which could have prevented the problems initially.

231 n49 Id. at 34.

231 B. Wyoming, North Dakota and Montana

231 Wyoming, North Dakota and Montana along with six other western states contain over 53 percent of the nation's coal reserves; n50 however, the strip-mining of coal in these states is embryonic compared to the development of this industry in Kentucky and West Virginia. n51 Thus the legislation of these

states provide marked contrast to their eastern counterparts for it usually lacks specificity as to what reclamation requirements must be fulfilled by the operator.

231 n50 G. Sullivan. Land Reclamation Problems and Their Effect on the Nation's Coal Industry, WESTERN RESOURCE PAPERS 185 (Vol. 8, 1966). Of the coal resources in the nation, Wyoming contains 7 percent of the total; North Dakota contains 20.5 percent and Montana contains 12.5 percent. U.S. GEOLOGICAL SURVEY FUTURE GROWTH 52 (prepared at the request of Senator Mike Mansfield, 1964).

231 n51 ENVIRONMENT, supra note 2 at 115, app.I. table 11.

231 In Wyoming, an operator pays a fifty dollar fee n52 and performance bond n53 of an amount determined by the commissioner of public lands who administers the reclamation act. n54 The nature of the restoration program is left almost entirely to the discretion of the mine operator who need only submit an annual report stating what steps have been taken to reclaim the mined area. n55 The only mandatory requirement is that peaks and ridges be graded to a rolling topography. n56 Only "if practicable" must the operator seal the exposed coal seam with at least two feet of cover and revegetate. n57 If he fails to comply, there is no specific provision made for penalties.There is no minimum bond required nor is a specific amount set out to be collected in case of forfeiture. Furthermore, Wyoming's reclamation statute excuses any operator who has completed strip mining on an area prior to the effective date of the act from any obligation to reclaim these orphaned lands, n58 but omits any provisions as to how these areas will be restored.

231 n52 W.S. 1957, @ 30-96.5(7).

231 n53 Id. @ 30-96.8.

231 n54 Id. @ 30-96.10.

231 n55 Id. @ 30-96.6(e).

231 n56 Id. @ 30-96.6(a).

231 n57 Id. @ 30-96.6(c), (d).

231 n58 Id. @ 30-96.4.

{232} In 1967 the Montana legislature set forth the standard of "useful production" for reclamation of those lands on which strip-mining of coal had been conducted. n59 The act incorporating this standard provides that the

Montana Bureau of Mines and Geology is authorized to enter into contracts with those operators presently strip-mining coal in the state to provide for reclamation of those lands affected. n60 By entering into such a contract, any strip coal mine operator may annually receive credit against his license tax in an amount equal to one-half of the reasonable value of the reclamation work

done in the previous year. n61 Such reasonable value is determined by the Bureau which inspects each operation annually and reports its findings to the state board of equalization. n62

232 n59 R.C.M. 1947, @@ 50-1001 to -1004.

232 n60 Id. @ 50-1002.

232 n61 Id. @ 50-1004.

232 n62 Id.

232 The term "reclamation" is not defined specifically by the 1967 act, but its statement of policy encourages reclamation of stripped land to avoid soil and stream pollution by returning the land to useful production. n63 This is the only mention made of any standard for reclamation but what constitutes useful production is not defined. Moreover, the major portion of the statement of policy is devoted to a descriptive analysis of the coal production potential of this state and the legislature's determination to implement such production as soon as possible to enhance the economic welfare. n64 The act omits any specifications of reclamation standards to be met by mine operators in their contracts and by such omission, leaves the determination of such standards to the Bureau. Furthermore, no provision is made for penalizing operators who fail to reclaim.

232 n63 Id. @ 50-1001.

232 n64 Id.

232 At best, the 1967 act can only be defined as a step-forward or an indication of interest by the state in acknowledging that a reclamation problem does exist in Montana. Its practical effect was merely codification of existing practice. Apparently the glaring deficiencies of the act prompted further legislation from the 1969 session. n65 While the 1969 act carries over the standard of useful production, it defines productive use to include reforestation, revegetation for grazing or cropharvest, wildlife refuges, lakes or ponds, and recreational or industrial sites. n66 From its expression of concern over improving or maintaining the tax base and safeguarding the health

and welfare of the people as well as the aesthetic value of the land, contrary to the 1967 act, the latest statement of policy seems more environmentally-oriented. n67

232 n65 Id. @@ 50-1005 to -1007.

232 n66 Id. @ 50-1005.

232 n67 Id.

232 Under the 1969 enactment, any operator who engages in strip-mining where the overburden exceeds ten feet in depth n68 has the option of either contracting for the reclamation of the area disturbed or obtaining a permit to mine from the Bureau. n69 To obtain a permit, the operator must submit a bond which attaches to the acreage affected and payment ranging from a $25 fee and $7.50 per acre for areas of ten acres or less to a $2 75 fee and $2 .50 per acre for areas exceeding fifty acres. n70 These fees are deposited in the general

fund in the state treasury. n71 The permit can be renewed annually without payment of any additional fees. n72

232 n68 Three-fourths of the ecoal deposits in Montana lie in beds 120-1,000 feet below the surface. U.S. GEOLOGICAL SURVEY AND BUREAU OF MINES, supra, note
50 at 49.

232 n69 R.C.M. 1947, @ 50-1007.

232 n70 Id. @ 50-1008(2) which states in part: For an area of ten (10) acres of less to be affected during the permit term, a fee of twenty-five dollars ($2 5) and an amount equal to the amount of seven dollars fifty cents ($7 .50) multiplied by the number of acres to be affected between two (2) and ten (10) acres, inclusive, for an area of more than ten (10) acres but not more than fifty (50) acres to be affected during the permit term, a fee of one hundred dollars ($1 00) and an amount equal to the amount of three dollars fifty cents ($3 .50) multiplied by the number of acres to be affected between eleven (11) and fifty (50) acres, inclusive: for an area of more than fifty (50) acres to be affected during the permit term, a fee of two hundred seventy-five dollars ($2 75) and an amount equal to the amount of two dollars fifty cents ($2 50) multiplied by the number of acres to be affected in excess of fifty (50) acres. Upon the receipt of the application, a bond or security and all fees due from the operator, the commission shall issue a permit to the applicant which shall entitle him during the permit term to engage in surface coalmining on the land therein described.

232 n71 Id. @ 50-1012.

232 n72 Id. @ 50-1008(5).

{233} Under the permit system, an operator is required to submit a reclamation plan not later than the first day of December following the first year of the permit term, n73 this plan designates the productive use to which the land shall be reclaimed. The operator must grade all peaks and ridges to the original grade or one in conformance with the use designated in his plan n74 as well as revegetate the disturbed surface in accordance with the use proposed. n75 Reclamation must be completed within three years of the expiration of the permit, with an allowable extension not to exceed five years. n76 However, the 1969 act deems an area reclaimed after the second seeding or planting, whether the seeding is successful or not. n77 If the operator fails to reclaim the land affected by his strip-mining, he forfeits $2 00 per acre of the bond deposited and upon forfeiture, is released from any further obligation to reclaim the affected area. n78 When forfeiture occurs, the Bureau is empowered with the authority to reclaim the affected area. n79

233 n73 Id. @ 50-1009(8).

233 n74 Id. @ 50-1009(1)-(5) which states:

233 (1) All ridges and peaks of land affected by surface coal mining within six hundred sixty (660) feet of existing right of way and which are visible from any public road maintained with public funds, public building or cemetery that is being maintained in a usable condition, shall be graded to a rolling topography traversable by machines necessary for maintenance in accordance with planned use, with slopes having a grade no greater than the original grade of the overburden of that area prior to mining.

233 (2) The operator shall construct earth dams, where lakes may be formed, in accordance with sound engineering practices if necessary to impound water, provided the formation of the lake or ponds will not interfere with underground or other mining operations.

233 (3) On all affected land which is to be afforested the operator shall construct reasonable access roads through the area.

233 (4) On all affected land which is to be seeded to pasture the operator shall wherever reasonable stake off all peaks or ridges to a minimum width of thirty-five (35) feet at the top.

233 (5) On all affected land which is to be used for crops including hay, the operator shall grade peaks and ridges and fill valleys in such manner that the reclaimed land will not have grades greater than the original grades of the overburden of the area prior to the coal-mining operation.

233 n75 Id. @ 50-1009(9).

233 n76 Id. @ 50-1009(10).

233 n77 No planting is necessary where pools or lakes may be formed by rainfall or surface runoff. Id.

233 n78 Id. @ 50-1011(5).

233 n79 Id. @ 50-1011(6).

{233} North Dakota's requirements are substantially the same as the 1969 reclamation act of Montana, n80 except in two areas. The permit system is used exclusively n81 and its reclamation act is administered by the state mine inspector n82 under the auspices of the state public service commission. n83

233 n80 N.D. @@ 38-14-01 to -14-13.

233 n81 Id. @ 38-14-04.

233 n82 Id. @ 38-14-11.

233 n83 Id. @ 38-14-02(12).

233 IV. PROPOSED REVISIONS FOR MONTANA

233 The preceding discussion illustrates the diverse approaches to reclamation and poses problem areas to which states are still seeking practical solutions.Who should administer the reclamation process to insure compliance by industry? What method of regulation of strip mining best insures the reclamation of land? What is the minimum amount that should be required in performance bonds to achieve adequate reclamation? Are penalties on forfeiture high enough to encourage reclamation by the operators instead of the state?

233 A. Voluntary Contract v. Permit

233 Superficially it appears that the specific requirements set out in Montana's 1969 reclamation act indicates a maturation of legislative minds

regarding the needs for insuring restoration of strip-mined lands; however, that act failed to rectify the most patent loophole in the 1967 legislation, that is, permitting reclamation on the basis of a contract without setting standards that must be included in the contract.Out of all the state legislation previously discussed, Montana stands strikingly alone in this permissive concept.It is of little surprise that of all the strip-mining operations presently being conducted in this state, none of the operators chose to employ the permit method. n84 The numerous weaknesses of the contract system are exemplified by the following provisions extracted from an agreement presently in effect in Montana: n85

{234} (a) a plan of reclamation must be submitted within twelve months after mining has commenced but designation of the productive use is entirely in the operator's discretion based on technical and scientific knowledge available. However, adoption of the plan is based on the value of the land surface prior to mining, the cost of reclamation and the reasonable value of the surface after reclamation;

234 (b) peaks and ridges were to be graded to a width of fifteen feet at the top;

234 (c) coal seams were to be covered with at least two feet of earth or spoil material unless already covered by two feet of water;

234 (d) in final cuts and other depressed areas where water could collect, no backfilling and revegetation was necessary;

234 (e) planting could be held in abeyance for ten years to allow for natural weathering and leaching of toxic material and, if at the end of that time, plant growth was still inhibited, then the area would be considered unplantable;

234 (f) a performance bond of approximately two hundred dollars per acre (exact amount unknown) was required; and

234 (g) reclamation was to be completed within three years after the adoption of the reclamation plan. This contract was subject to termination by mutual consent or by either party upon giving six months notice. Any amendments to the agreement had to be approved by both parties.

234 n84 MONT. LAW FORUM 3 (1970). "The state now has weaker voluntary contract [sic] with four coal companies . . . They are: Knife River Coal Co., Peabody Coal Co., Western Energy Co., and Rosebud Coal Sales Co." The Missoulian, Dec. 16, 1970 at 16, col. 6.

234 n85 The material included in the following paragraphs (a)-(g) was

obtained from a contract entitled "Surface Coal Mine Land Reclamation Agreement." To maintain anonymity, the mine operators are not identified. Access to these contracts is not readily available unless one is located in the Butte area. A Bureau spokesman stated that these contracts are open to public inspection at the Bureau of Mines and Geology; however, no copies would be sent out if requested.Interview with Robert Matson, Bureau of Mines and Geology, by telephone, December 21, 1970.

234 It is evident that such agreements do not provide the state with authority to prohibit or prevent detrimental effects from occurring or permit the state to insert new reclamation procedures into these operations without the agreement of the operators. Furthermore, the agreement makes no provision for its enforcement, thus necessitating court action by the Bureau.

234 Effort has been made within the last year to alleviate the leniency of these contract terms by creating a model contract form which more adequately insures restoration of the strip-mined area. n86 In the most recent draft the contract incorporates many of the reclamation requirements present in the permit sections of the 1969 statute:

234 (a) before mining commences the operator must submit a reclamation plan designating the productive use to which the land shall be restored to the Bureau which must be approved or disapproved within sixty days of its receipt; n87

234 (b) the Bureau will work in conjunction with an Advisroy Committee composed of a member from the following: Soil Conservation Committee, Fish and Game Department, Office of State Forester, Department of State Land and Investments, Water Resources Board, Department of Planning and Economic Development, and the Department of Health; n88

234 (c) measures which prevent erosion and pollution require an operator to provide drainage controls, cover the coal seam, stockpile removed soil and replace it at a depth sufficient for plant growth on slopes of 2:1 or less, grade spoil banks to a minimum width of twenty-five feet, unless otherwise specified, and remove or bury waste material; n89

234 (d) vegetative cover in accordance with the land use designated need only be provided "to the extent reasonable and practicable" and only two seedings are required; n90

234 (e) payment of a performance bond or a reasonable alternative in a minimum amount of two hundred dollars per acre disturbed; n91 and

234 (f) reclamation is to be concurrent with mining operations "as feasible"

and completed within a "specified reasonable length of time." n92 The latter term is not defined. The contract may still be terminated by mutual consent or by either party giving six months notice if all the "obligations arising from mining operations already conducted have been performed." n93

234 n86 Montana Council on Natural Resources, Surface Coal Mine Land Reclamation Contract, Draft Copy (October 30, 1970); see also The Missoulian, Dec. 16, 1970 at 16, col. 6.

234 n87 Model Contract, supra note 86 at Sec. I.

234 n88 Id. at Sec. I and Definitions (k).

234 n89 Id. at Sec. II (c)-(f).

234 n90 Id. at Sec. II (b). But see Sec. II (k).

234 n91 Id. at Sec. VI.

234 n92 Id. at Sec. II (1).

234 n93 Id. at Sec. IX. Upon failure to complete reclamation within the time specified, the Bureau may enjoin further mining, sue for damages for breach of contract, for payment of performance bond, or for both. Sec. III.

234 While providing slight improvement over previous agreements, the deficiencies of the proposed model contract expose the fallacies of the contract system. Ambigious terms fail to bind the operator to complete reclamation within a specified, predetermined time, to revegetate at all if some determination of impracticality is made, or to conform, if he refuses, to reclamation procedures that may be deemed necessary in the future. In order for the state to maintain its control over strip-mining reclamation and to assure the public that adequate restoration will be accomplished, it is mandatory that the voluntary contract system be abolished. Testimony at a meeting of the Governor's Conference Committee on Mined-Land Reclamation emphasized the necessity for this action n94 but apparently failed to make any impact on the Committee whose later recommendation was to retain the contract system and repeal certain provisions of the 1969 statute pertaining to the permit system. n95

234 n94 CONFERENCE, supra note 12 at 4.

234 n95 Id. Recommendation V at 60.

{235} B. Administration

235 As noted earlier, administration of reclamation procedures in the various states has been entrusted to various entities: specially-created divisions of reclamation, the commissioner of public lands, the state mine inspector, and in Montana, the Bureau of Mines and Geology. The obvious fault in allowing the Bureau this power is that it is basically industry-oriented; there is little, if any, check and balance provided. n96 Discussion on removing the administrative power from the Bureau at this point may be moot in light of the re-organization of state agencies that will take place; however, it is essential to recognize what type of administrator is necessary.

235 n96 Id. at 4.

235 In West Virginia and Kentucky, the Division of Reclamation operates under the auspices of the Commission on Reclamation, composed of the director of natural resources, the chief of the division of reclamation and the director of the department of mines. n97 This would be a workable solution for the administration dilemma in Montana. The Governor's Conference Committee initially recommended that the administration should be placed in the state land commission; n98 however, it later emphasized the necessity of a commission which would be free from partisan political pressures and suggested that a qualified expert be hired by the land board on a tract basis, or as an alterantive, that a professor of mined-land reclamation be established at Montana State University who could also serve as the administrator. n99 Most recent releases indicate the Committee has vetoed the latter proposal and the choice now lies between the water resources board or a new board. n100

235 n97 W.VA. CODE @ 20-6-6; KRS @ 350.024.

235 n98 CONFERENCE, supra note 12, recommendation V at 60.

235 n99 The Missoulian, Oct. 6, 1970 at 16, col. 1.

235 n100 The Missoulian, Dec. 20, 1970 at 18, col. 1.

235 C. Adequacy of Performance Bonds

235 The most controversial concern in the reclamation issue is determination of the basic costs of restoration of coal strip-mined areas and where the burden of these costs should be allocated.Industry-oriented groups claim that making the miner pay the total costs discourages the attraction of industry into the state thus reducing state revenues; taxpayers, on the other hand, are outraged if reclamation costs are passed on to them in the form of increased taxes. Most

of the uproar stems from inadequate cost data analysis as to what is financially necessary to attain various reclamation objectives. In order to fill the statistical void, the federal government has been studying reclamation programs throughout the nation. n101 In 1967, the Department of the Interior estimated that the cost of a basic reclamation program included approximately $100 to $200 per acre for revegetation and $1 00 per acre for minimum grading of area stripping to confine silt and sediment and cover toxic materials. n102 At the minimum then it costs approximately $2 00 per acre merely to control erosion and pollution; however, to develop a stripped-area to a productive use level, the expenditures increase.

235 n101 ENVIRONMENT, supra note 2 at 82.

235 n102 Id.

235 Rehabilitation of stripped areas to cropland use requires at least an estimated $600 per acre; for rangeland, $5 00 per acre; for recreational purposes, close to $700 per acre; and for wildlife habitats, $4 00 per acre. n103 These figures indicate that in Montana, where the legislative policy directs reclamation in rehabilitative terms, restoration costs of its 3.1 million acres of potential coal reserves reach staggering proportions. n104

235 n103 Id. at 84.

235 n104 Reclamation costs in the Fort Union area are estimated in the range of $300 to $8 00 per acre, broken down as follows: (1) leveling to a rolling topography, $200; (2) opsoiling, $1 50 to $400; and (3) revegetation, $50 to $200. CONFERENCE, supra note 12 at 28.

{236} To place this seemingly onerous burden on industry alone reinforces its lament that it will reclaimed out of business. n105 but the latter survey also indicates that in 1960 the approximate reclamation costs per ton of lignite coal mined by stripping in Montana ranged from .013 dollars to expend $300 an acre for reclamation to .034 dollars for $8 00 an acre. n106 Therefore, reclamation even to the luxurious point of providing a productive use seems achievable at minimal costs to industry. A British industralist noted that after meeting the extensive restoration requirements in England, the average cost of this reclamation was one dollar per ton of coal mined; but even after meeting this cost, his company managed to make a profit of two dollars per ton on strip-mined coal. n107

236 n105 For industry's viewpoint. see T. Gwynn, The Effect of Strip Mining on the Human Ecosystem, Dec. 12, 1969 (unpublished public relations report of Montana-Dakota Utilities Co.).

236 n106 The precise breakdown is as follows: $.013 to expend $3 00/acre; $.017 for $400/acre; $.021 for $500/acre; $. 026 for $600/acre; $.030 for $700 and $.034 for $800/acre. ENVIRONMENT supra note 2 at 114, app. I, table 7.

236 n107 Proceedings of the White House Conference on Natural Beauty, supra note 22 at 326.

236 Montana presently recovers only $2 00 per acre on bond forfeiture under the model contract form and the 1969 permit system. n108 This amount affords only minimal basic reclamation; it would not finance most rehabilitative programs. If the state legislature intends to accomplish the reclamation ideals declared in its statements of policy, bond penalties must be increased.

236 n108 Model Contract supra note 91; R.C.M. 1947, @ 50-1011(5).

236 IV. CONCLUSION

236 Certainly there are no quick, simple solutions to the reclamation problems in Montana; however, this comment dispenses inescapable conclusions that can no longer be ignored. Although the Appalachian situation has not occurred in Montana, the devastation of that area can be attributed in part to political hedging of state governments which acted belatedly from hindsight rather then foresight.

236 Legislation must be initiated which corrects the ills of past enactments. Regulation of the reclamation process must be stregthened before acreage disturbed by strip-mining coal and other minerals and fuels reaches insumountable proportions. Adequate reclamation cannot be accomplished by requiring revegetation "to the extent practicable and reasonable" and then relieving the operator of further obligations after the second seeding; by allowing an operator to place the burden of restoration on the state by forfeiting a bond of a mere two hundred dollars per acre; and by allowing reclamation to be a product of the bargaining table.

236 The permissiveness of the contract system cannot be tolerated. To insure complete regulation of the reclamation process, operators must be required to obtain permits which place specific obligations on them to complete designated restoration requirements. Administration must be placed in an entity that is not a mere extension of the mining industry. As long as provisions for hearings and appeal exist, industry has the opportunity to state its position. In designating an administrator, consideration should be given to the technical expertise necessary to plan all aspects of reclamation programs. Funds must be allocated to promote research in accomplishing successful revegetation, land planning and cost analysis. The amounts of bond forfeitures must be increased to secure adequate financing of mined-land restoration. If orphaned land areas

exist in Montana, monies to reclaim these areas should be a cost of industry under provisions similar to West Virginia.

236 While the earth lies victim to public apathy and abatement of pollution is a political foil, more landscape will disappear and, perhaps, irreparable injury to our environment will occur. If this is the cost of industrial-economic progress, it will be borne by future generations who may someday echo Thoreau's lament.

236 SANDRA MUCKLESTON.

STATE-FEDERAL RELATIONSHIP

INTRODUCTION

SUMMARY OF STATE SURFACE MINING AND MINED LAND RECLAMATION LAWS

[Department of Interior, October 1, 1971]

			License and/or permit requirements		Penalty for failure to reclaim				
State	Code citation	Minerals covered	Application	Fee	Penalty	Bond requirements	Reclamation requirements	Forfeiture of bond	Denial of new permit
			Application		Grade peaks to rolling topography; cover face of toxic material; divert water to reduce				

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solid must be 0 for than $1 with a
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ial Surface 50 than 00 per soil
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Georgia 1969. stone. d. $500. . $500. e. Yes Yes.
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Mining permit d land
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Idaho mining. ces. d. d. roads. Yes No.
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s 1971. s d. d. on. acre. cover. Yes Yes.
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ve Jan. clay, plan is plus $1 to permit use
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Indiana 1968. shale. d. acre. fine. issued. ves. Yes Yes.
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Maine 1971. gravel. on. 00. es. acre. ion. Yes No.
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between
peaks
to
restore
terrain

Maryland	Strip mining laws of the State of Maryland, 1969. Effective July 1, 1969. Regulations effective June 24, 1970.	Coal	Application for license and permit must be filed with the Director, Bureau of Mines. Reclamation plan is required.	License fee $100 plus $10 renewal. A special reclamation fee of $30 per acre must accompany permit application.	License - $5,000 to $10,000 or 6 months' imprisonment, or both. Permit - $5 00 to $5,000 fine.	$400 per acre, $3,000 minimum.	to as near normal as possible, satisfactory to the director. Revegetation is required. The operator is required to deposit a revegetation bond of not less than $50 nor more than $125 per acre of land affected. Reclamation of the affected land must be performed in accorda	Yes	Yes.

nce with the previously approved reclamation

plan which contains measures for surface gradient restoration suitable for proposed land use; revegetation or other surface treatment; public health and safety; disposal of mining debris; diverti

Any ore,	Exploration	ng water

rock, license to
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other permit erosion
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k clay, board Not s and
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cuts;

Ohio	1965.	Ch. 1513, Reclamation of Strip-Mined Land. Effective	C Coal	Application for license must be filed with the division of forestry and reclamation. Reclamation plan is required.	$75 plus $1 per acre.	$300 to $1,000 fine. Each day constitutes a separate offense.	$300 per acre, $2,000 minimum.	impound water. Bury acid-forming material. Plant trees, shrubs, legumes, or grasses upon spoil banks and upon final cuts unless covered by water. Grade to reduce peaks to a rolling topography. Construct earth dams in final cuts; impound water. Cover exposed face of mineral	Yes	Yes.

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Oregon 1972. use. d. $2 5 1,000. mined. on. Yes Yes.
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Effecti tion Annual impriso nal where
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vania 1, mineral require fee of or require ons
n1 1972. s d. $300. both. ments. permit. Yes Yes.
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Effecti tion $6 per impriso with a ation
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Virgini 27, mineral require maximum or minimum practic
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Washington	Surface Mined Land Reclamation Act, ch. 64, laws of 1970. Effective Jan. 1, 1971.	Metallic ore, coal, clay, stone, sand, gravel, and any other similar solid material.	Application for permit must be filed with the department of natural resources. Reclamation plan is required.	$25 per year plus $5 per acre exceeding 10 acres which was disturbed during the previous year.	No amount specified.	$100 to $1,000 per acre.	topography. Bury acidforming material. Grading and backfilling to be done with nonnoxious, nonflammable solids. Cover the face of coal and disturbed area with material suitable to support	Vegetative cover required appropriate to the future use of the land.	Yes	Yes.

vegative cover; bury acid-forming materials, toxic material, or materials constituting fire hazard; impound water. Bury all debris. The law also contains requirements for regrading surface-mined areas where benches result specifying the maximum bench width allowed

West Virginia	Art. 6, ch. 20, the code of West Virginia, as amended. Effective Mar. 13, 1971.	Coal, clay, flagstone, gravel, sandstone, shale, iron ore, and any other metal or metallurgical ore.	do	$500; annual renewal fee $100. A prospecting fee of $3 00 is required.	$100 to $1 ,000 fine or 6 months' imprisonment or both. Willful violation not less than $1,000 nor more than $ 10,000 or by imprisonment not exceeding 6 months, or both.	$500 per acre	. On land where benches do not result complete backfilling is required but shall not exceed the original contour of the land. The backfilling shall eliminate all high walls and spoil peaks. Planting is required. Grade to reduce peaks and ridges to a	Yes	Yes.

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Wyoming 1969. s. lands. $50 . ioner. able. Yes No.
[See Table in Original]

240 n1 Member of the interstate mining compact.

240 Note: Public lands: Title 43, pt. 23, Code of Federal Regulations, "Surface Exploration, Mining and Reclamation of Lands." Indian lands: Title 25, pt. 177, Code of Federal Regulations, "Surface Exploration, Mining and Reclamation of Lands."