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QUARTERLY
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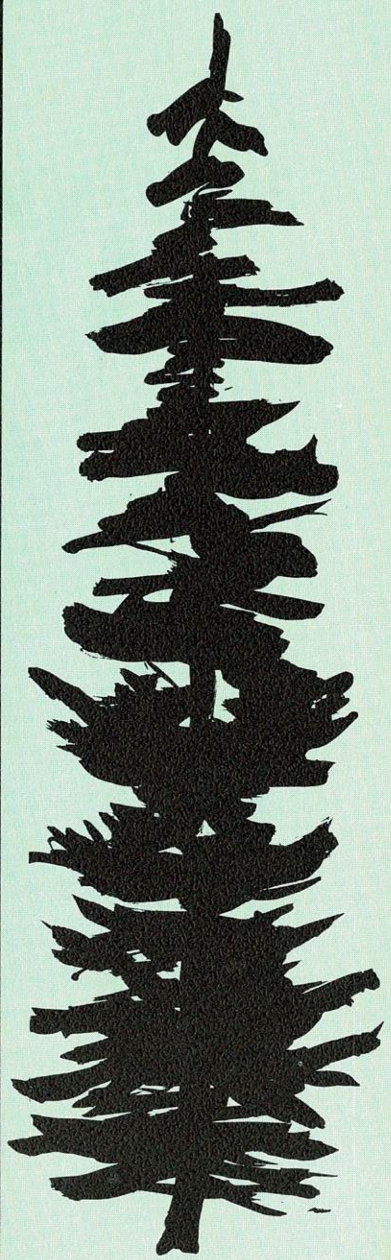

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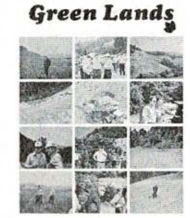

ABOUT THE COVER

The 1974 Interagency Evaluation of surface mining in West Virginia was conducted throughout the state from July 22-26. The tour covered reclamation sites from Raleigh County in the south, to Harrison County in the north, and proved to be another great success. Cover photographs depict some of the scenes of the five-day event.

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'40s look is no longer in style on strip jobs

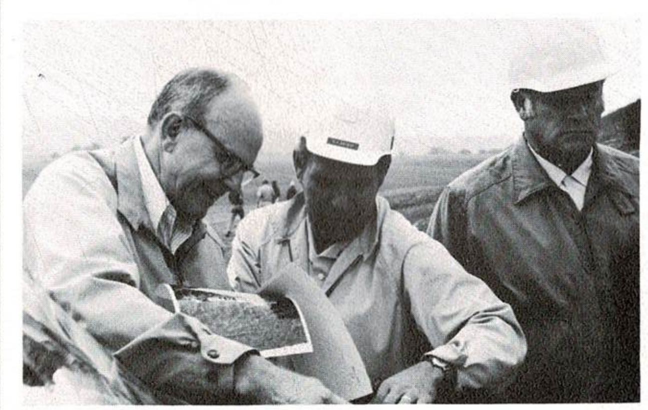
By HARRY L. BAISDEN
Herald-Dispatch Staff Writer

(Reprinted with permission of the Huntington Herald-Advertiser)

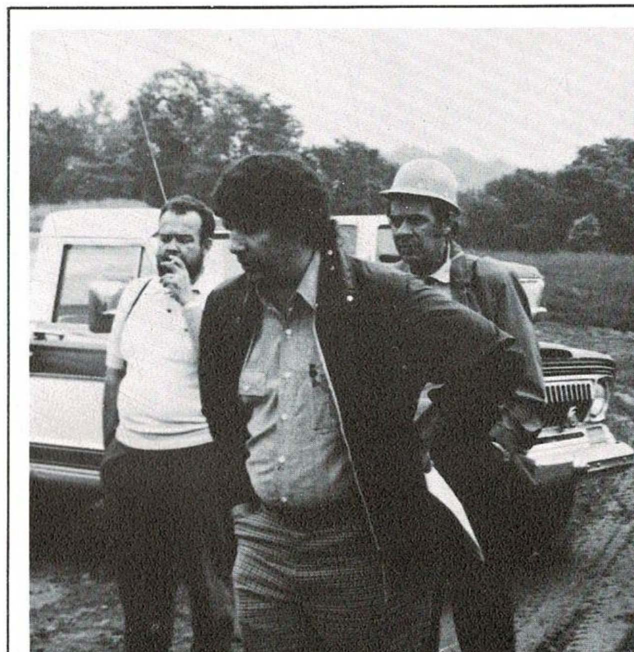
In the 1940s and 50s, strip mining in West Virginia was a matter of scooping earth and rock off the top of coal seams and dumping that material over the nearest mountainside.

During that era, once the coal was removed, the operator more often than not moved on to the next mountain, leaving behind ugly highwalls, water and rock-filled gashes in the land and barren mountainsides with their vegetation ripped loose or covered by non-productive sub-soil.

That image has changed today. The change was evident during a tour of reclamation efforts in the state conducted by the Department of Natural Resources last week. On the tour were specialists from various governmental agencies and industry.



Ted Briskey of the Bethlehem Mines Corporation and Frank Glover of the Soil Conservation Service study "before and after" photos of mine site in Nicholas County. Mining and reclamation work here has been overseen by Fil Nutter, Sr., (right) president of Hobert Mining and Construction Company.



State Reclamation Chief Ben Greene, who coordinates the Interagency Evaluation each year, discusses the importance of annual on-site study of reclamation progress throughout the state.

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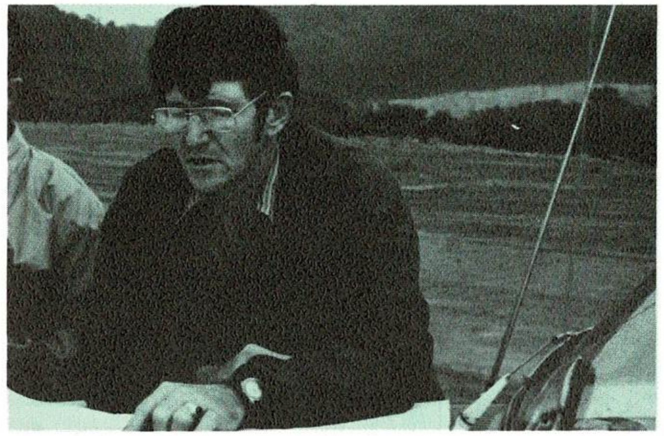
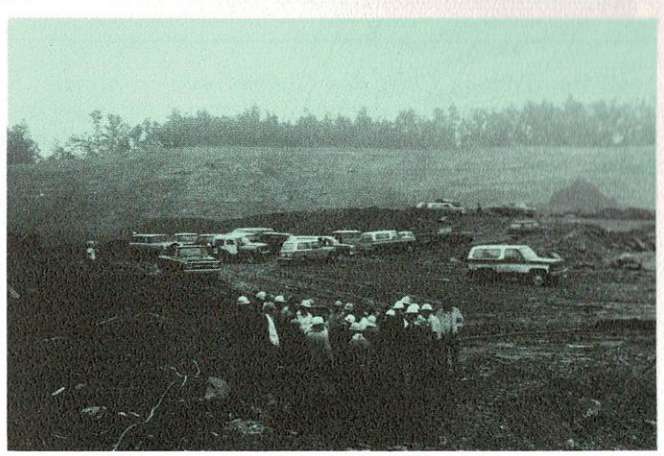


Detailed and accurate pre-planning are of the utmost importance for a successful mining project. State Engineer J. D. Brachenrich studies the pre-plan maps for this southern West Virginia site to determine if the company followed its original guidelines.

Jim White of the Pioneer Fuel Company is an annual fixture on the evaluation tour representing the industry. He and Frank Glover study results of a direct seeding experiment near Beckley that was established two years ago by the Ranger Fuel Company.



At each site the group would get together and discuss the operation with the local inspector and company officials, before beginning their evaluations.

Today the spoil removed from atop the coal seams must be controlled to prevent erosion, stream siltation and landslides. Also, vegetation must be left on the material left behind by the strippers and water from stripping operations must be controlled both in the mining pit and along the slopes of spoil material.

Complying with these requirements has forced the operators to add to their staff such specialists as engineers, agronomists and water quality experts. And it has forced them into more sophisticated and preplanned operations that account for the regulations.

The operators have come up with numerous new methods of mining the coal that allows them to continue operating within the law.

Such terms as valley fill, haulback, gabion structures and mountain top removal all are part of a lexicon of modern strip mining unknown 20 years ago.

Haulback is a method of overburden handling which eliminates the objectionable practice of dumping the unwanted overburden over the side of the mountain. Operators employing the principal add to their inventories huge material hauling trucks identical to those seen working on highway construction.

The material taken from above the coal is loaded into the trucks and is hauled back around the mountain and dumped into the pit behind where the coal is being removed.

Huge construction pans also can be used for this purpose in some kinds of terrain. Xcello Corp., for example, has a strip mine in Fayette County near Kingston, W. Va., using the pans to redistribute overburden.

But a DNR inspector said pans could not be used at a Hobet Mining and Construction Co. job in Nicholas County because the area is too rough for them. That 150-acre project is a mountaintop removal mine in an area that previously had been stripped with little or no reclamation.

In the steep slopes of southern West Virginia most operations (other than mountaintop removal) utilize bulldozers and endloaders for removing and loading the spoil and off-road trucks for handling the overburden. Endloaders scoop out of the coal and load it on large coal trucks.

Highwalls, the steep rock faces left on the uphill side of a mountain strip mine once the coal is removed, form the basis for a major controversy in the surface mining issue. Environmentalists and relamationists generally want them eliminated, but the industry argues it either costs too much or can't be done in steep slopes like those common in West Virginia.

But highwall elimination is not uncommon in the state. Hobert's job on Sewell Mountain in Fayette County started as a mountaintop removal project, but the company changed to contour mining with highwall elimination when the coal seam got too thin for economical mining by mountaintop removal.

In the area already mined, Hobert has left a regraded and seeded slope of some 30 degrees with no highwall. Participants in the tour, however, pointed out that because the job is being done in an area previously stripped, the highwall elimination was able to be accomplished.

Universal Coal Corp. of Buckhannon is mining coal from a site in Upshur County where they have backfilled the pit eliminating a highwall that originally rose 105 feet above the bottom of the coal seam.

When the material above the coal is removed, it usually needs more space for backfilling than is available in the already mined pit. To compensate for this, a valley fill operation often is employed.

In valley fill overburden material is hauled to a hollow or valley either on or adjacent to the area being mined. Before the material is dumped in, graded and compacted, a rock core made from huge rocks dumped into the center of the fill is created to carry runoff water off the site underground.

The core and surrounding areas then are covered with the overburden. Long valley fills also are terraced at intervals to break the long slopes.

Tour participants inspected the rock core of a valley fill being constructed by Xcello near Kingston. The core was not yet covered by other material and offered a close look at the materials used in it to allow water to flow through.

Valley fills often are utilized with mountaintop removal projects where the dirt and rock from atop the coal has to be stored somewhere other than against a highwall.

Strip mining in West Virginia is different from that in the flatlands of the Midwest and the western Great Plains because the mountainous terrain here prevents the use of such huge power shovels and raglines as The Captain and Big Muskie from being used.

But shovels and draglines are used here. During the tour, the group visited two Cherry River Coal and Coke Co. sites in Nicholas County where smaller imitations of the huge flatland machines are being used.

The company is mining coal for Island Creek Coal Co. from a 2,400 acre permit, the largest existing permit in the state. In use at the mountaintop removal job is an electrically powered shovel with a bucket capable of scooping up 22 cubic yards of material every time it takes a bite.

Gene Matheson, Island Creek's northern division manager, said the 20-year-old shovel was purchased from Ohio Rep. Oakley Collins, R-Ironton, a long-time Lawrence County surface mine operator.

At a nearby site the same company is using a dragline with a 15 cubic yard bucket. Matheson explained that the different types of machines are being used because the overburden material at the 2,400 acre mine is harder sandrock, making a shovel a better machine than a dragline to remove the material.

Controlling the water from an active surface mine is a problem operators must face. Uncontrolled runoff water carries with it silt which can choke out and fill mountain streams.

In the steeper slopes of southern West Virginia, gabion structure dams usually are used to keep the silt out of the streams. These dams are built below the surface mine and catch the water as soon as it leaves the site.

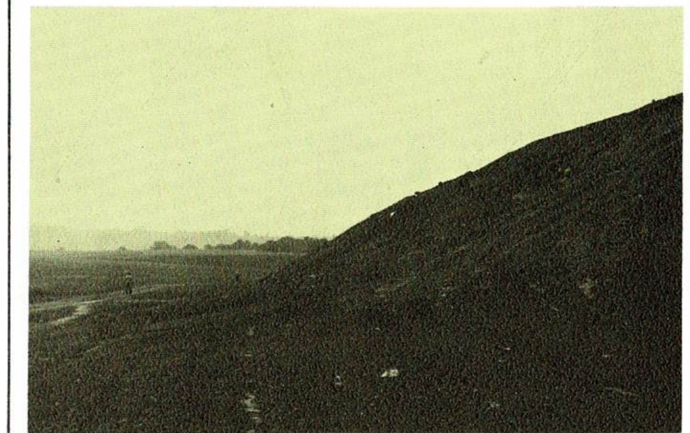
A gabion is a heavy wire basket that is filled with rock (which must meet DNR specifications of hardness — simple sandstone won't do.) The baskets are stacked across a small stream leading from the site.

Gabion dams allow water to pass through, thereby eliminating large and potentially dangerous impoundments: but they slow down the flow long enough to allow the material washed off the strip mine to settle out as sediment.

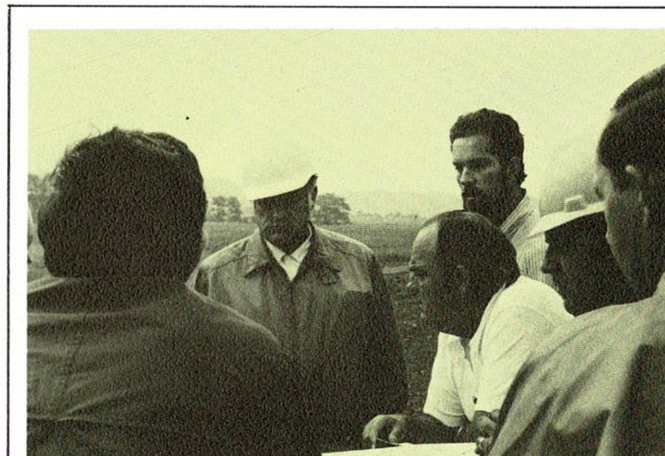
The dams are periodically checked and the sediment is removed when needed.

Complex drainage systems also are designed into the mining operations to control the water flow. The Hobet job visited in Fayette County has a drainage feature unique in the state.

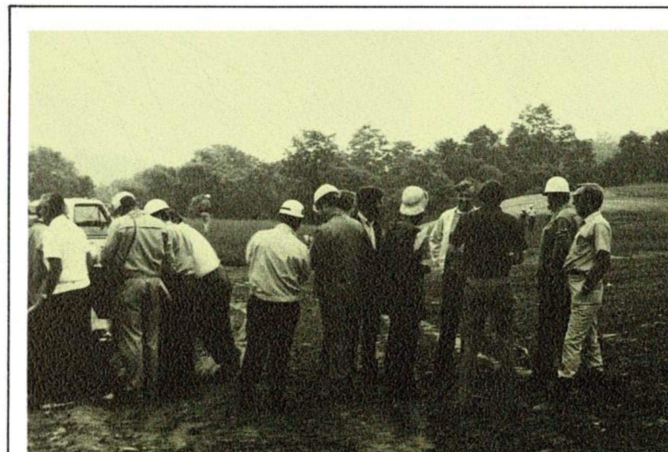
The company constructed a flat, shallow drainage ditch around the base of the entire operation. The ditch eliminates the need for a lot of on-site ditches and off-site sediment ponds. **(Continued on Page 7)**



Highwalls and spoil piles are out, in todays surface mining operations. In view of pending federal legislation and administrative guidelines by the state, the trend is towards the "haul back" or mountain-top removal.



Kenes Bowling, Executive Director of the Interstate Mining Compact, made his first appearance on the evaluation tour, and show interest in Hobet's mountain-top removal job in Nicholas County.



Review and discuss of each operation by the group is an important part of a successful evaluation. Bob Koswoski and Glynn Cooke of Mountaineer Seeding and Reclamation explain methods utilized in contract reclamation work.

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Following preliminary review of the pre-plan, the groups divided into smaller groups for specialty evaluation. Examining the results of experimental direct seeding of hardwoods is Lowell Haga, Joe Parker and Pete Pittsenbarger of the Reclamation Division and Dave Ozrina (second from the rgiht) of D & D Reclamation.

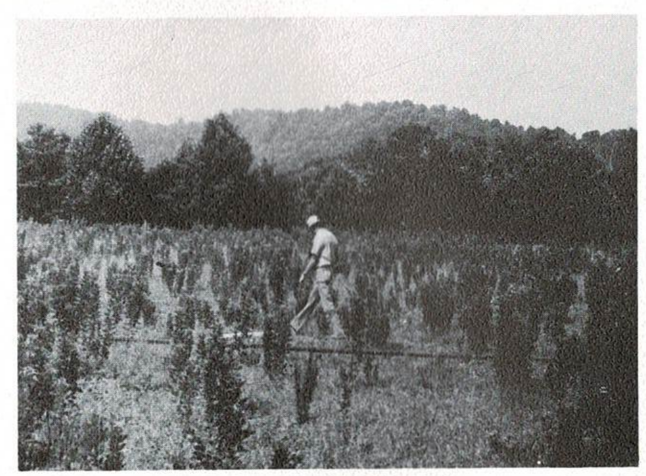
William Casto, Hobet's general superintendent at the mine, said the ditch, though more expensive to construct that siltation ponds, may be more economical in the long run. "We don't have to maintain roads to offsite ponds," he said, "and when the silt builds up in the ditch we just run a piece of our regular equipment in to clean it out."

But Hobet admits the ditch was easy to construct since the mine is on the site of earlier strip mining where a bench already existed, making the area more accessible for ditching equipment.

The new methods are expensive and add to the price of strip mined coal, but at least one operator thinks it's worth it.

Lawson W. Hamilton Jr., president of Xcello and of the West Virginia Surface Mining and Reclamation Association, said the Fayette County job is producing half the coal with twice the equipment used in previous methods.

"If they're willing to pay for it, we're glad to do it this way," he said. "We're proud of this job."



Representatives from several federal agencies participated in the tour. Dave Simpson of the U. S. Bureau of Mines makes a personal evaluation of revegetation efforts on this Raleigh County site.

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RECLAMATION OF STEEP SLOPE SURFACE MINING

Presented By

Lawson W. Hamilton, Jr., President
West Virginia Surface Mining and Reclamation Association

at the

American Mining Congress 1974 Coal Convention
Pittsburgh, Pennsylvania
May 8, 1974

Gentlemen, I am Lawson W. Hamilton, Jr. and have been involved in mining coal by underground and surface methods for some 28 years in both Kentucky and West Virginia. Predominantly, my experience has been in the steep slopes of southern West Virginia, and today I shall be discussing mining operations on slopes there that vary between 40 and 70 degrees in steepness.

Because I have been involved in surface mining for this period of time, I can look back and realize how drastically our methods of mining and reclamation have changed. The industry has progressed from the early days when a vertical drill, dozer and a shovel simply uncovered the coal and cast overburden haphazardly over the out-slopes, to today, when three months of engineering and preplanning are necessary to pinpoint the mining and reclamation plan from start to finish long before the first yard of dirt is moved. Today's complex methods of mining coal on the steep slopes require millions of dollars of equipment and split second timing in order to maintain production and protect the environment. We, in the industry, now feel that as much time, effort and money is spent on assuring revegetation and stabilization of mined land, as is involved in the actual production of coal. Furthermore, reclamation begins during preplanning and is integrated as part of the total operation throughout. Everything we do from the standpoint of production, is geared toward the final product, which is sound reclamation.

As few as five years ago, most state surface mining laws allowed the spoil materials produced by surface operations to be pushed down the outslope into the valleys below. Whether the materials were comprised of tremendous boulders, pyritic material or slate and clay, it mattered not. But, when the environmental movement reached its peak in the latter 1960's, and the overall effects of such methods were brought to light, the public began demanding a better performance from both the industry and the state regulatory agencies. In the past few years, we have seen a change in attitudes, nationwide, that will dictate exactly what our industry can or can't do in the future. Those who react to these trends and adapt to their requirements will be the leaders in the future.

The State of West Virginia moved quickly by passing one of the nation's toughest surface mining laws in 1967 and amending it in 1971. Basically, the law requires bonding, reclamation taxes, engineering and preplanning, complete drainage systems for water control, backfill, regrading and finally revegetation and stablization of the disturbed area. Obviously, these strengent requirements have had a detrimental effect on our industry's productivity, but those of us who have survived are quite proud of our reclamation achievements. West Virginia has led the nation in total acreage reclaimed each of the past five years, while ranking only fifth in production. By early 1973, we felt we were able to do all that was necessary to mine coal, protect the environment and comply with the law. But once again, changing attitudes on what reclamation should be, have required further revisions in our mining methods. With both houses of our federal congress considering bills that call for total highwall elimination, with no spoil on the outslope, surface mine operators in mountainous regions have been developing new methods that will comply with such standards. However, the West Virginia Department of Natural resources jumped the gun a bit about 18 months ago by establishing administrative guidelines that would make our steep slope operations comply with these new federal requirements.

This new steep slope mining theory has been labeled "controlled placement" of spoil. Basically, this method of mining guarantees continued mining in mountainous areas with continued aesthetic beauty through elimination of highwalls and spoil piles. When I say "controlled placement," I am borrowing a phrase from the chief of the Reclamation Division of the West Virginia Department of Natural Resources Ben Greene, who I feel named it properly. "Controlled placement" is a broad general term which means the placement of spoil in steep areas where its condition can be completely stabilized and revegetated. This covers the head of valley fill, mountain top removal, haulback, over the shoulder, block cut and any other methods where the overburden is technically delivered, hauled or compacted so that there is no adverse after effects when mining has been completed.

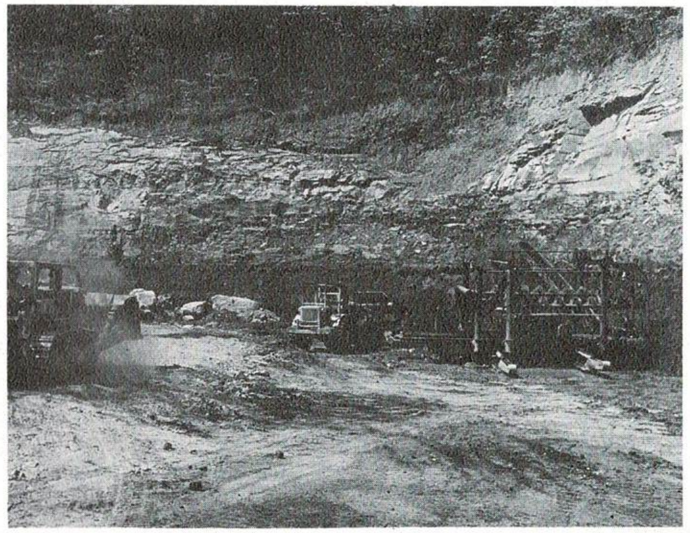
At the present time in southern West Virginia, under these new guidelines, there is no overburden being placed on slopes greater than 28 degrees or 50 percent. Of course, from a mining technology standpoint, this creates several problems; foremost being the swell factor of the material removed from the pit. When you're operating on a 75 foot wide bench on a 33 degree slope, five or six hundred feet above the valley floor, with two dozers, two front end loaders, two 40 ton haulers and an auger, placement of the expanded spoil can became a problem. Whether you haul it in trucks or loaders or push it with a dozer, the tree line must be maintained with no spoil on the slope. So, obviously, we are utilizing highwall backfill and head of the hollow fills to achieve successful mining and reclamation under these difficult circumstances.

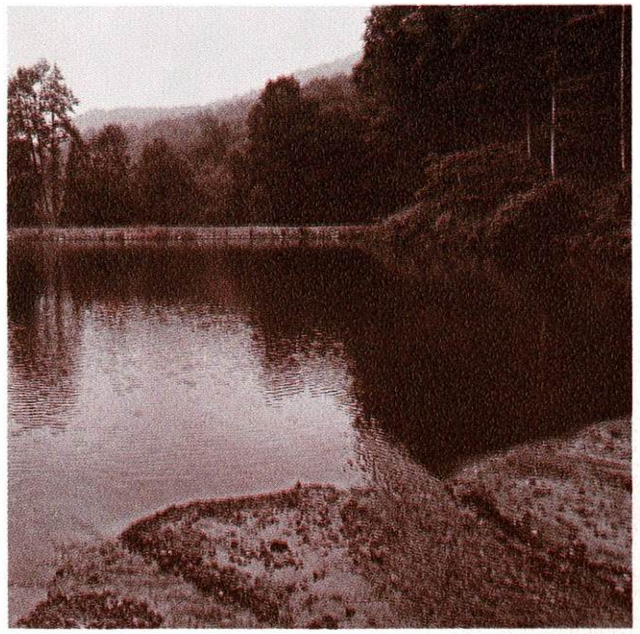
In order to show you in detail the method of operation now being utilized by myself and others in steep slope areas, I have brought several slides, which I should like to share with you. Most of the slides are of my own operation and I shall entertain any questions after this meeting that you might like to ask. However, I have also included a few other slides with my own, in order to present a good cross section of some other "controlled placement" methods being utilized on southern West Virginia's steep slopes.

Before any displacement of soil or uncovering of the coal seam transpires, a complete drainage system must be engineered and installed. This includes silt ponds, silt retarding dams, acid treatment facilities, if necessary, and haulroad water control through use of drains and culverts. These drainage systems guarantee that siltation does not leave the disturbed area and find its way into the main streams and tributaries of the watershed below the mining operation. So, as I mentioned earlier, reclamation actually begins before mining. Siltation structures can either be "dug out" or excavated below the natural level, or dams erected above the natural level.

These ponds are riprapped with stone material on both the input or up-stream waterways and the downstream discharge waterway. By riprapping the spillways, we can help insure that they will not undercut and wash away during periods of heavy rainfall.

The silt basins are normally excavated by a dozer, but smaller ponds and drainways can be installed with equipment such as the gradeall. This type machinery is also effective in cleaning and maintaining these drainage structures throughout the duration of the operation. A small dragline or clamshell can also be used for this purpose. Depending upon the amount of mining activity in the watershed above, these ponds usually require cleaning about twice a year.





As I mentioned earlier, some of the methods of water retention and filtration are built above ground, such as the gabion dam, which is constructed of rock filled wire baskets. This type structure is relatively new to surface mining drainage systems and we have found them very effective so far.

Our largest gabion structure is some 100 feet in length with the bottom course consisting of 3 feet x 3 feet baskets filled with 3 inch x 10 inch limestone rock. Each end of this dam is dead manned into the virgin bank with steel cables running through each layer of basket for stabilization. They have proven quite effective in containing sedimentation. Again, this type structure does not impound water per se, but only slows the flow so the sedimentation has time to filter out. Incidentally, the water from this structure, which is just one part of the total system, flows downstream to another regular type settlement pond some 2,000 feet below.

In order to comply with stringent drainage requirements under our reclamation laws in West Virginia, as the mining progresses and the disturbed area increases, we develop a series of siltation structures that make up the total drainange system. Any surface water in this area must pass through, not only one but sometimes three and four of these ponds, fully insuring that no contaminated or muddy water enters major waterways below the mining site.

Only after the drainage system is completed by the operator, and passes state inspection, is the permit granted, so that we can start the actual production cycle. Here again, keep in mind that "controlled placement" restricts us from placing any spoil material over the side on slopes greater than 28 degrees. The problem of what to do with this material is compounded by the fact that any time you disturb virgin earth, it expands nearly 100 percent. In other words, one yard of compacted overburden becomes three or four yards of spoil material. How can we handle the additional volume of material? Well if we're fortunate, we can deposit the initial cut on abandoned surface mine benches that adjoin the operation or in some isolated cases, we can utilize natural level points or mountain tops that lie near the coal seam. However, in most cases, we must utilize a valley fill or head of the hollow fill.

In order to begin a valley fill, the head of the particular hollow must be cleared of all existing vegetation and timber before the disposition of material begins. It is mandatory that a rock core be constructed to accommodate the flow of water which is anticipated from elevations above the operation, and also to insure that the structure has a good solid base.

On the job which I'll be discussing, we ramped a makeshift haulroad into the fill area, in order to facilitate dumping the coarser material to the bottom with front-end loaders. In this case, the material is dumped over the side with gravity action, allowing the rougher materials to find their way to the bottom, creating the base of the valley fill. As the fill material rises, a dozer is utilized in compacting this material in four foot layers and placing the larger rocks in the center to form the rock core necessary for drainage.

After the drainage system is completed and approved and the initial cut disposed of in the valley fill, the operator should have enough room to begin surface mining by the haulback or lateral movement method.

As the operator begins the second cut, reclamation is once again the first priority. All top soils and sub-soils that are suitable for supporting vegetation are segregated and stockpiled, so that they can be brought back in for final regrading. After the sandstone and shale materials have been drilled and shot, they are loaded into off-road haulers and begin their lateral movement along the bench to the fill area. At this time, all black shaley material that will not support vegetation, and all pyritic materials that could cause acid drainage are also segregated and backfilled into the pit first. These materials from what eventually will be the base of the highwall backfill. Often times, if available, a dozer is used to feed the broken material to an end loader, speeding up the overburden removal and helping to insure that no material is deposited on the downslope.

The next step, of course, is recovery of the coal, which is accomplished by a front end loader and highway trucks, which haul the mineral off the hill. This stripping sequence will repeat itself until the coal-to-overburden ratio gets to the point that it would not be economical to take another cut into the highwall. At this time, if coal seam conditions are acceptable, we can realize further coal recovery through augering. There are different avenues of thought on augering a coal seam, particularly in terms of locking up coal reserves from future production, but I have let one factor be my guide. The auger production from my jobs has helped significantly in off-setting the added costs of the haulback method. But as I mentioned, augering can also be detrimental to a haulback operation because it can slow your lateral movement. Augering must be completed, continuously, in time for the backfill of spoil material from the pit. If this timing cannot be consistent, you will lose manhours, production and the advantages of augering in the first place.

This situation is compounded when the seam that you are working has two splits. The top split has to be augered, the rock parting removed, then the bottom split has to be loaded and then awaits the arrival of another auger before this particular area can receive the spoil from the stripping operation.

On this particular operation we are mining the lower Powellton Seam in Fayette County, West Virginia, which is divided into four distinct splits. I think you can imagine the extremely intricate job the superintendent has on his hands in stripping, loading and augering these various splits. Often times, the success or failure of an operation depends on how well your superintendent can handle this intricate work.

This haulback method requires advanced mining technology and equipment utilization. Split-second timing between men, machinery, overburden removal, coal removal and spoil disposition is required around the clock in order to realize full production. Under these conditions, down time on machinery can be disastrous. Also, under our West Virginia Reclamation Law, we have only 90 days after augering in which to have backfilling and regrading completed. We are then required to reseed the area to grasses and legumes during the first growing season, which under present conditions, is about eight months out of the year.

On one of my operations recently completed near Kingston in Fayette County, West Virginia, the area was seeded with Kentucky 31 Fescue, Perennial Rye Grass and Serecia Lespedeza just last fall. The progress of revegetation is coming along well, but again, under our law, it must remain under bond for at least two growing seasons before the state will even consider it for release. Then after this time period, if the inspectors are not totally satisfied with the results, which means we have not met the requirements of 80 percent total cover, we are responsible for coming back in and doing spot reseeding. This process can go on until the state inspectors are satisfied that we have achieved the required vegetation cover.

Gentlemen, as you can see, surface mining technology, particularly in the mountainous regions, has developed into a detailed science equally involving men, machinery, production and reclamation. Whether operating in the rugged mountains of Appalachia or The Great Plains of the West, we have long since passed the days of mining the coal and leaving the reclamation to nature. Over 50 percent of all the coal mined in the U.S. this year will come from surface mining. This provides us with a great opportunity, but an even greater responsibility. During this time of energy crisis and environmental concern, it is up to the industry to develop methods, regardless of the terrain, that will afford maximum production and protection of the environment.

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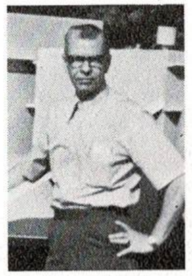

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THE DAVIS PROJECT

From Black to Blue

Steve H. Blizzard
West Virginia University

Steve L. Shaffer
Davis Trucking Company

Since the 1880's, the small community of Davis, West Virginia has been associated with the color black. Located in mountainous Tucker County on the Blackwater River, it is famous for its Blackwater Falls State Park and resort areas. But most important, Davis owes its existence and the majority of its maintenance to the large deposit of high grade black coal located nearby.

For many years, coal has been removed from this area with little regard to reclamation or possible future land use. With recent emphasis being focused on environmental problems, the coal operators of the area are doing an excellent job of reclamation. However, the Davis Trucking Company, in association with West Virginia University Division of Plant Sciences, is going one step further. Not only are they reclaiming the strip area, but they are establishing various horticultural crops such as apples, blueberries, blackberries, grapes and raspberries.

When considering the Davis area or most other sites in West Virginia for a possible planting site, five major problems arise: 1. Temperature – the temperature can drop to —20°F during January and February producing winter injuries or killing of plants. Also there are unpredicted spring frosts to contend with. 2. Soil fertility is often low to say the least which can be expected in disturbed soils with newly formed profiles. 3. Soil acidity which on most sites will range from 4.0 to 6.5. 4. Soil water seems to be either too much or too little. 5. Soil organic matter (O.M.) which is usually very low due to the clearing process and lack of vegetation.

As one tries to choose a plant for production keeping these factors in mind, the blueberry seems to meet the requirements. Blueberries thrive on sites of relatively low fertility, have a pH range of 3.8 - 5.0, can withstand temperatures of —35°F, can tolerate excessive or limited water supply, and require minimum O.M. Blueberries also have an extremely fibrous root system which is very advantageous in areas which may be an erosion problem.

The blackberry also fulfills the requirements with the exceptions that it does not do well with low amounts of O.M. and does poorly with extremely low soil pH. Also the raspberry seems to fall in this category of fruit however, it also has the blackberry's problem with the soil pH and O.M. levels, and the soil moisture must also be maintained more closely. Like the blueberry, the brambles also produce an extensive root system. Figure 1.

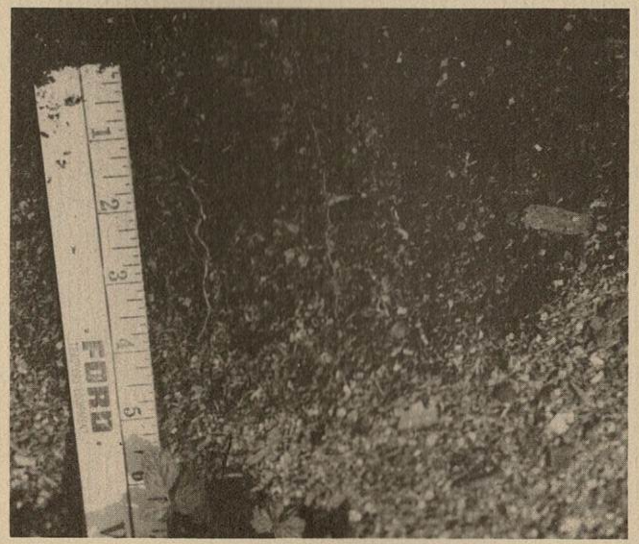

Figure 1. Raspberry plant after one growing season demonstrating approximately eight inches of lateral root growth.

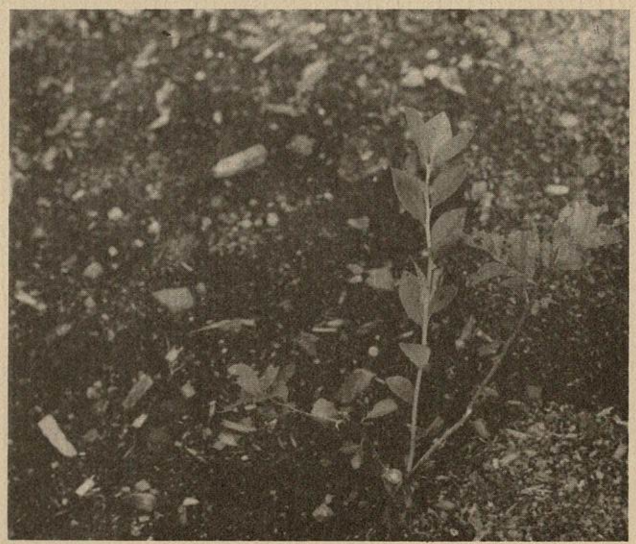

Figure 2. One year old blueberry cutting exhibiting approximately nine inches of terminal growth after one growing season under sawdust mulched conditions.

Figure 3. Raspberry growing in newly reclaimed soil with no mulch added. An average cane growth of thirteen inches was observed with approximately three canes per cutting.

With the requirements of these three fruits in mind, one can very simply alter the sites to fit the growth styles of each. Excess water can be removed by use of diversion or drainage ditches, or by simply planting to the higher side. Of course, the problem of fertility and pH can be simply overcome with the utilization of inorganic fertilizer and lime. However, the problem of supplying O.M. is not so easily solved.

Affiliated with Davis Trucking Company are several saw mills which in turn have excess sawdust which is an excellent source of O.M. Many saw mills in the area have excess sawdust, through it can be sold to charcoal plants. Many outlying mills do not find this economically practical and would be glad to give it away for its

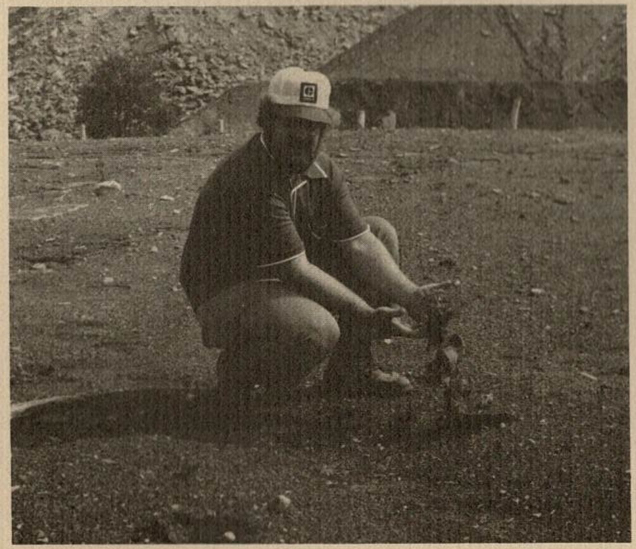

Figure 4. Author Steve Blizzard illustrates raspberry plant growing under mulched conditions producing a single thirteen inch cane.

removal. Sawdust not only serves as a good source of O.M., but it helps to condition the soil and forms a buffering system in the newly formed soil profile, thus preventing the rapid loss of nutrients and moisture.

The Davis project was divided into three sites to decide proper slope, exposure, wind orientation and mulch requirements. Site A was gently sloping, 5 - 10% with an eastern exposure, planted perpendicular to prevailing wind flow, and completely mulched with 6" of sawdust. It was composed of approximately 2.5 acres planted with 800 blueberries at 8' x 8' spacing, 400 blackberries at 6' x 6' spacing, 600 raspberries at 6' x 6' spacing, and 25 apple trees at 6' x 12' spacing.

Site B was nearly level, with a 3 - 4% slope, with a southwesterly exposure, planted parallel to prevailing

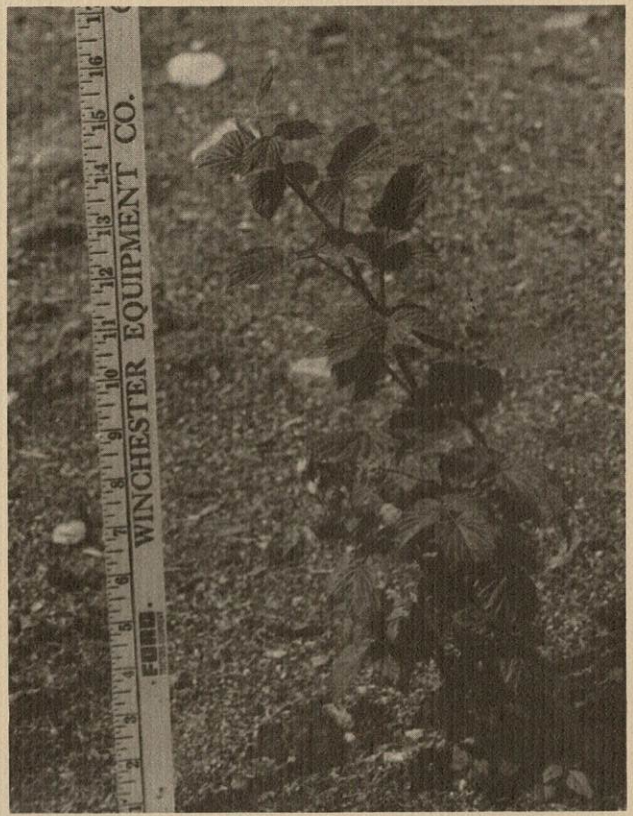

Figure 5. Blackberry plant showing an excellent 16 inch terminal growth after one growing season under mulched conditions on newly reclaimed strip-mined soil.

wind flow, and one half mulched with 6" sawdust. It was composed of 3.2 acres planted with 800 blueberries at 8' x 8' spacing, 600 blackberries at 6' x 6' spacing, 400 raspberries at 6' x 6' spacing, 25 apple trees at 6' x 12' spacing, and 50 grapes planted at 12' x 6' spacing.

Site C, not yet completed, was located on a nearly level bench, completely protected from the wind with a southeast exposure. At present only 25 apple trees are planted with no mulch added. All sites were newly reclaimed, stripped land, mined during 1972-73. Soil preparation included leveling, and application of 1000 pounds per acre of 20-20-20. Lime was applied only to areas intended for apple trees and grapes at the rate of 1.5 tons per acre.

Results:

After one growing season the blueberries on both sites showed an average of 77% survival, the mulched areas doing best with 90% survival. Figure 2. Wet sping conditions, young plants, rodents, and wind damage were the four major factors for loss.

Raspberries yielded a 73% average survival with the unmulched areas showing best results. Figures 3, 4. Wet spring conditions, poor planting conditions, and wind damage were major factors for loss here.

Blackberries produced a 94% survival with mulched and unmulched areas showing little difference. Figures 5, 6. Wet conditions seemed to be the major cause for loss.

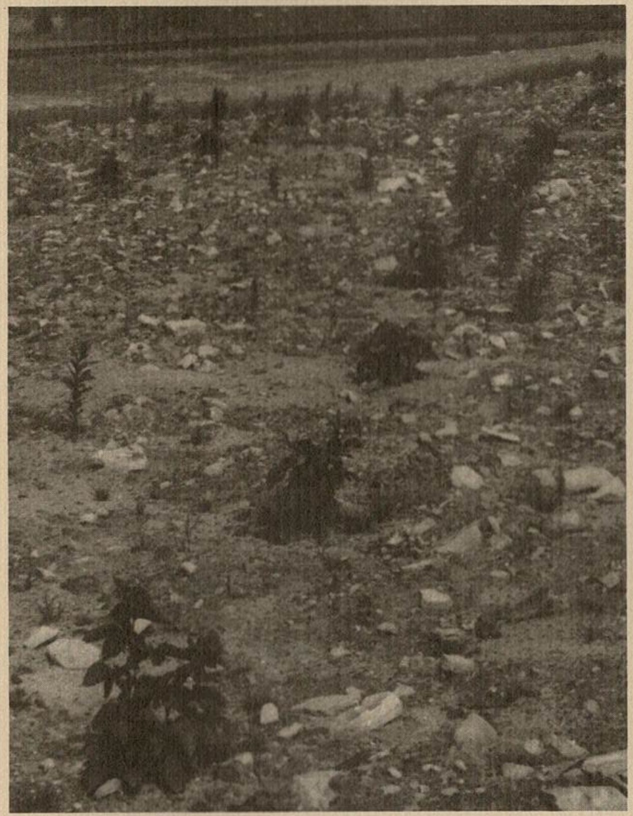

Figure 6. Blackberries growing in unmulched newly reclaimed strip-mined soil. An average of 15.5 inches terminal growth was recorded under these conditions.

All apples and grapes showed 100% survival with some slight damage from deer. Figures 7, 8, 9.

As was expected, rows oriented parallel to prevailing winds received less damage than did rows planted perpendicular to wind flow. This was a major factor in plant loss in Site A. When compared to Site B, which was oriented parallel to wind flow, Site A showed a 21% loss due to wind.

Of extreme importance is the exposure of the site. Site B, with its southwesterly exposure, produced a 28% greater survival rate than did Site A employing an easterly slope. This was due to the warming effects of the sun. The sun's rays striking a southern exposure all day in the spring, thus warming the soil, stimulating root growth and development. This allows the cutting

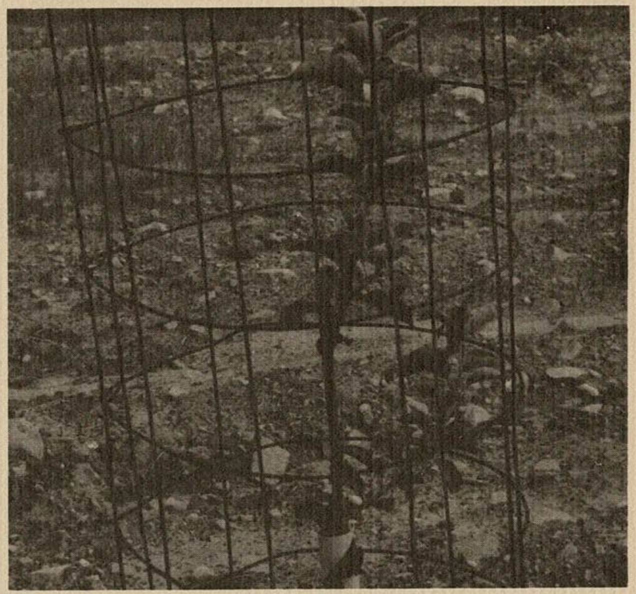

Figure 7. Two year old apple tree making good terminal and lateral growth. Concrete reinforcing wire was fashioned into a cage to protect trees from deer.

to establish a relationship with the soil and growth begins.

Several problems were encountered during the course of the experiment. Of major importance was the fact that one year old rooted cuttings were used for initial plantings. The root systems were not developed sufficiently to compete successfully in these reclaimed soils. Perhaps an older cutting or cuttings with larger root systems should be used to insure good survival. This problem will be investigated this year at West Virginia University in cooperation with Davis Truckng Company.

Figure 8. Researcher shows growth produced by grape plant after one growing season.

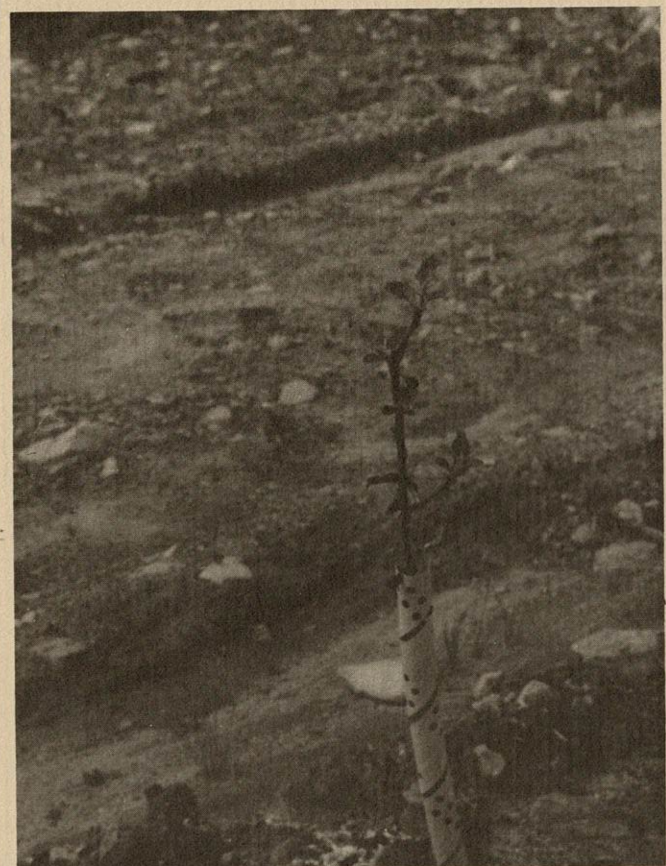

Figure 9. Unprotected apple tree severely stunted by deer. Plastic guard at base of the tree is used for rabbit protection.

Another problem occurred wth the use of sawdust as a mulch. Water erosion was severe on slopes as slight as 3% and wind erosion was a constant problem on all sites. Both wind and water erosion were a problem as far as the sites were concerned, however, they afforded an inexpensive method of spreading the sawdust over the entire reclaimed area, which would be extremely beneficial. On steep slopes another source of O.M. must be used such as straw or hay, or, if sawdust is used, it must be worked into the soil. A close watch must be maintained on the nutrient level of the soil if sawdust is used. The decomposition of O.M. requires large amounts of nitrate and other nutrients needed also by the plant. However, with proper soil testing, this is not a major problem.

In the author's opinion, these plantings have been extremely successful. Horticultural crops such as blueberries, raspberries, blackberries, apples and grapes not only offer a good revegetation and reclamation plant, but they can turn a handsome profit for the operation in the future.

Further research is currently being conducted to determine which varieties of various fruits both commercial and natural are best suited to this type of culture. Also, yield studies will be conducted with various fruits. This project is being expanded to cover larger acreages and more types of plants in 1975 with hopes that a better plant-site relationship can be developed.

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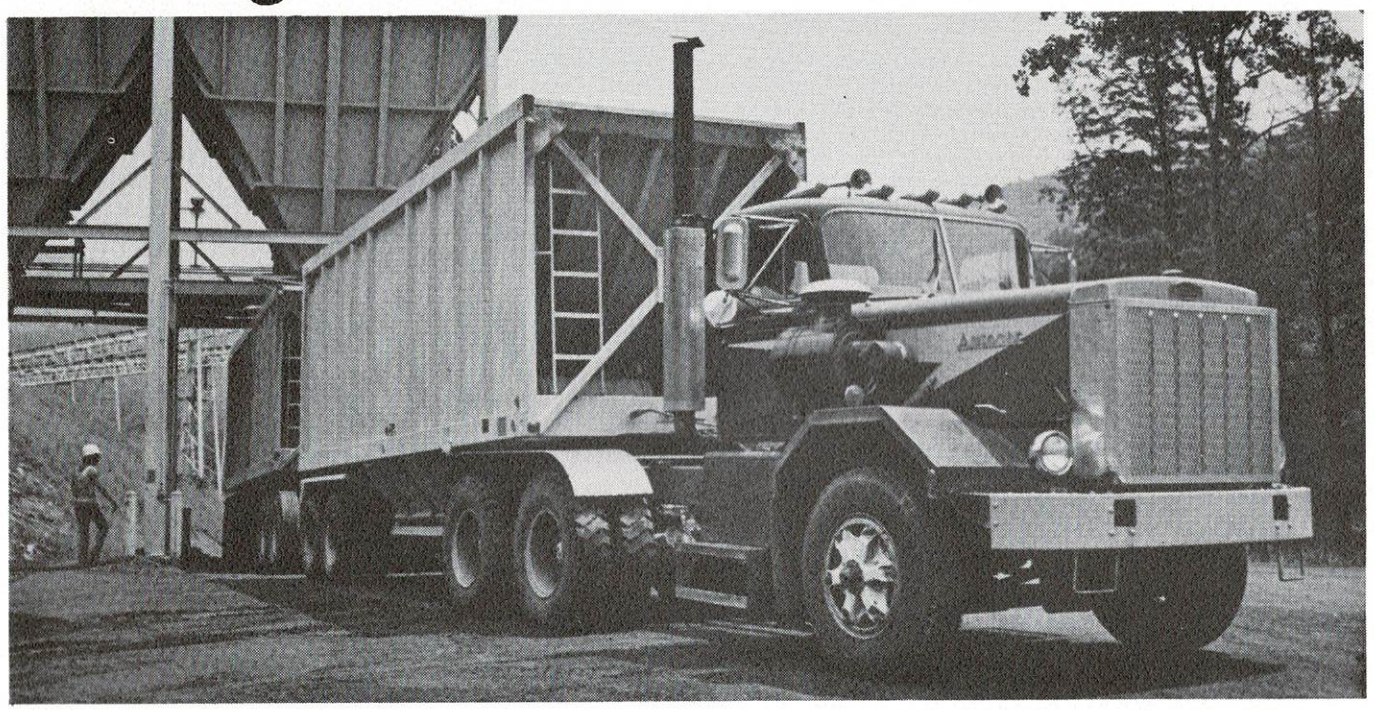

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SANDSTONE WEATHERING ON SURFACE MINE SPOIL

This article was compiled by M. T. Heald, Professor of Geology, WVU, G. E. Arnold, Consolidated Gas Co., and R. M. Smith, Professor of Agronomy, WVU. It is published with the approval of the Director of the West Virginia Agricultural Experiment Station as Scientific Article No. 1317.

Observations of many sandstone overburdens and sandstone-derived minesoils made throughout our studies indicate that there are large differences in the rate of breakdown of the sandstones after excavation. Recognition of overburden materials that are physically stable will allow better construction of french drains and outslope foundations; whereas readily weatherable rocks make better soils.

Properties of coal overburden and resulting minesoils that require greater attention than in the past are rate of breakdown or large fragments and capacity to retain water for plant growth and prevention of excess drainage or runoff. Detailed investigations of some of these physical properties of overburdens, principally sandstones, have been carried out at West Virginia University.

Weathering characteristics of different sandstone types

The rate of breakdown of sandstone mainly depends on original lithology and the extent and nature of weathering before excavation. In considering weathering behavior, the sandstone may be divided into 3 general groups: Calcareous Sandstone, Argillaceous Sandstones and Clean Sandstones.

Calcareous Sandstones

A sandstone cemented mainly with carbonate is hard at the time of evcavation but will break down rapidly as the carbonate is dissolved under weathering conditions. However, if the carbonate forms less than 20 percent of the framework of a sandstone cemented with quartz, voids will develop on weathering, but the rock normally will remain intact. In very highly calcareous sandstones, waters effecting weathering become readily neutralized so that these sandstones do not break down as rapidly as some of the less calcareous types.

Argillaceous Sandstones

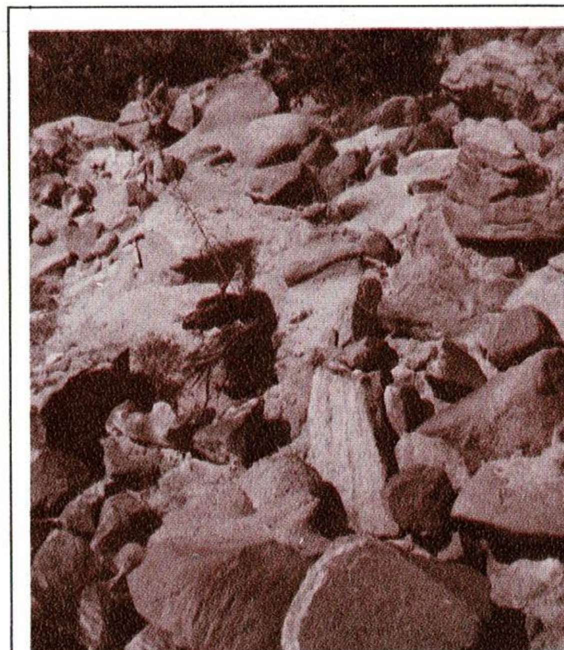
Argillaceous sandstones may vary considerably in rate of breakdown; some are very resistant to weathering and others deteriorate rapidly after excavation. Sandstones with closely spaces micaceous layers along bedding planes are hard when excavated but weather rapidly. Bonding is weak across the micaceous layers and slight expansion of the micaceous material on weathering causes splitting into thin sheets which then readily disintegrate. Blocks which are situated with the bedding verticle deteriorate most rapidly.

The agrillaceous sandstones that break down readily are generally tan or brown for the obvious reason that they have been oxidized during weathering near the surface. The argillaceous sandstones that have altered under reducing conditions are deceiving in that they are gray and superficially resemble fresh rock which would be resistant to breakdown. However, some of these sandstones are among the fastest to disintegrate. They usually can be recognized by the presence of soft clay in the interstices and a noticeable lack of brittleness when struck by a hammer. The altered argillaceous sandstones are particularly useful where additional sand would be beneficial in the soil.

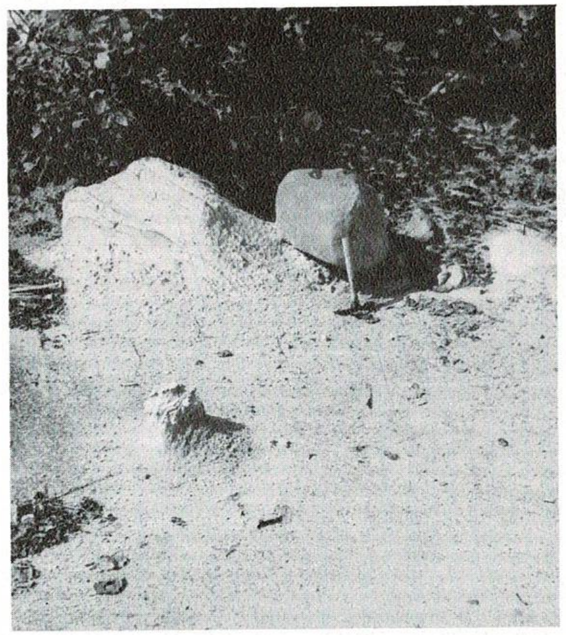
Some sandstones undergo spheroidal weathering in which onion-like shells form the outer part of the spheroids while the interior cores remain intact. The units range from one foot to six feet across. Spheroidal weathering best develops in argillaceous sandstones which are vertically jointed and free of closely spaced horizontal partings. Waters circulating along the joints and bedding planes apparently promoted alteration of the argillaceous material in these sandstones. Expansion attending this alteration causes shells to split away from the less altered core portion. Spheroidal weathering is particularly well-developed in the sandstones in the Summersville area of West Virginia and commonly extends to a depth of 25 feet below the surface. Some of the outer shells are so highly altered that they disintegrate into sand size particles on excavation. Inner shells are stronger but fragment into blocks which disintegrate fairly readily. The areas of spheroidally weathered sandstone are potential sources of both weak and hard sandstone. The material in the outer shells is weak and could furnish considerable sand for soil with proper reclamation planning. The hard cores are resistant to disintegration and could be utilized as fill where stable conditions are required.

Clean Sandstones

Even in clean quartz sandstones there is great variation in bonding; yet the factors controlling these variations are commonly difficult to ascertain. It is apparent that a sandstone with practically no cement will be very weak and one which is completely cemented under favorable conditions will be very resistant to breakdown. Some of the sandstones of Pennsylvanian age fall into these categories and their behavior under weathering conditions can be predicted with certainty. However, many of the clean sandstones fall between these two categories and reasons for differences in rate of breakdown are not readily apparent. One might expect friability to increase with porosity but the relationship is not simple. Some low porosity sands are friable whereas others with considerable porosity are strong.



This illustration shows sandstone rock fragments of many varying degrees of resistance to weathering. The fragments along side the hammer (upper left of picture) have almost completely disintegrated while some of the sharp-cornered fragments in the foreground are still quite intact.



Here we can see two quite different degrees of resistance to weathering of sandstones exposed on the surface of a minespoil.

The nature of the outcrop furnishes an important clue as to the resistance of the sandstone. The poorly bonded types have rounded edges rather than the angular shapes of the resistant sandstones. The erroneous conclusion is easily drawn that a sandstone found in large boulders is necessarily resistant. Some blocks of the Pottsville sandstone are at least as large as small houses; yet may be composed of relatively weak sandstone. Joints in the Pottsville are commonly widely spaced so that huge boulders develop in the normal processes of mass-wasting. Even with reduction in size through disintegration at the margins, these boulders will be of above average size for a long time.

Fortunately, the variations in strength of the clean sandstones are ordinarily apparent at the time of excavation. The weakly bonded types which will disintegrate readily, crumble with light hammer blows even in fresh speciment. On the other hand, the clean sandstones which are strong when excavated will remain essentially intact in spite of severe weathering conditions.

Blasting effects

Some sandstones are greatly weakened by shock near blast holes. Partings occur along concentric cylinders approximately parallel to the blast holes. In some cases the shattered zone is as much as 3 feet in diameter. Weathering is greatly facilitated by the presence of the partings and disintegration is relatively rapid. The strongest sandstones are not shattered by blasting but sandstones which show only slight signs of weakness may become very friable around the blast hole. Outside of the blast zone the sandstone is coherent and weathers very slowly. Blasting techniques probably could be adjusted to increase the amount of disintegrated material where additional sand in the soil would be beneficial. On the other hand, by employing procedures to minimize shattering, a greater supply of strong aggregate could be obtained where stable blocks, riprap, etc., is desired.

Summary

An entire sandstone body cannot be characterized as to its weathenirg behavior because of variations in lithology and differences in extent of alteration before excavation. However, with careful examination of natural outcrops in a limited area one can predict, at least in a general way, what the weathering characteristics of the sandstone will be in that area. If exposures are poor, it might not be possible to make a meaningful evaluation until the rock is cored or excavation is initiated. With a better understanding of the variations in breakdown of sandstones, it is possible to plan reclamation work more realistically and make optimum use of the excavated material.

This work was partially supported by the U. S. Environmental Protection Agency and the West Virginia Geologic and Economic Survey. The ideas and conclusions are those of the authors and not necessarily those of the supporting organizations.

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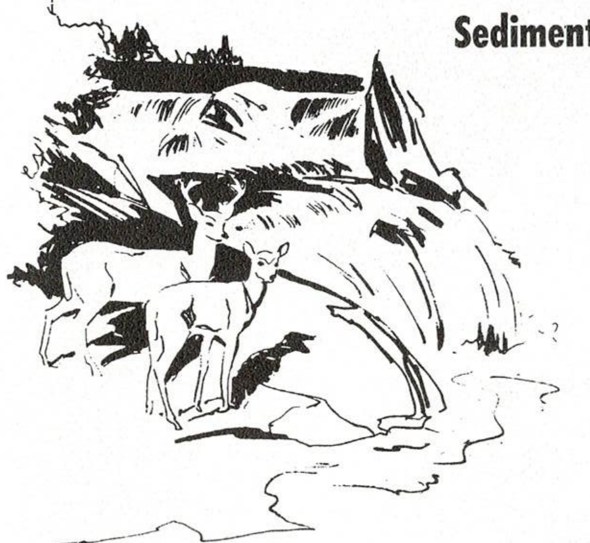

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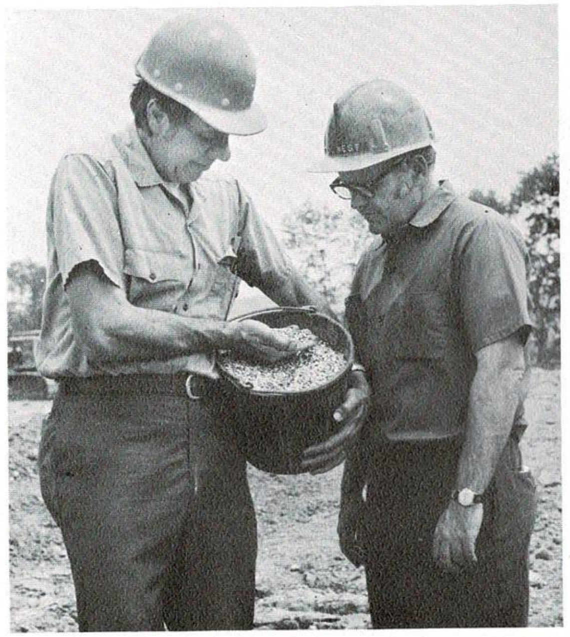


Experimental test seeding areas are expected to provide additional valuable information in restoring disturbed land. Direct seeding of grass, shrubs and tree seed mixtures have taken place on three areas at Saw Pit near Gary. The cooperative project is being supervised by W. T. Plass, principal plant ecologist, U. S. Forest Service, Princeton, W. Va. (left), and J. L. West, Gary District forester, shown examining one of the seed mixtures.

NATIVE HARDWOODS PART OF EXPERIMENTAL SEEDING

U. S. Steel has joined with the U. S. Forest Service, Northeastern Forest Experiment Station, in an experimental seeding project.

In making the announcement recently, A. E. Moran, general superintendent, Gary District, said, "We appreciate the opportunity of working with the U. S. Forest Service on this cooperative project. We hope the experiment proves successful in developing new and improved seed mixtures which can be utilized in restoring disturbed land."

Arrangements for the experimental seeding were developed by William T. Plass, principal plant ecologist, U. S. Forest Service, Princeton, W. Va., Jack West, Gary District forester, and Graham Talley, contour superintendent.

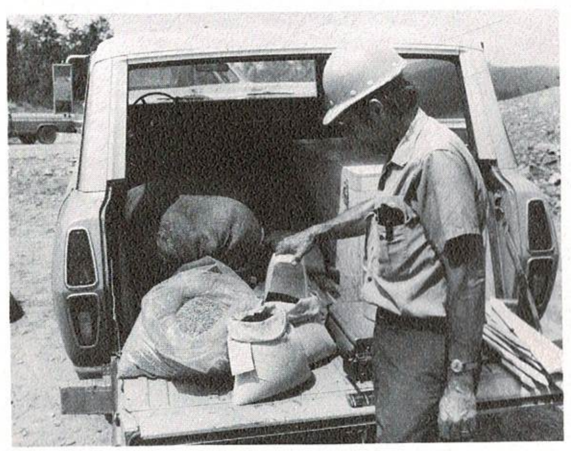
"Site protection, erosion control and esthetics are important considerations in surface-mine revegetation," Mr. Plass said. "However, greater emphasis will be placed on treatments that provide these benefits and at the same time establish a crop that will have economic value in the future. Forest products are important in southern West Virginia, and it would be desirable to reestablish productive forests on some surface mines. This experiment with U. S. steel provides an opportunity to test methods for seeding trees and shrubs and will assist our research scientists in developing new and improved methods for surface-mine revegetation."

Three test sites at Saw Pit near Gary, each totaling three acres, were selected for the seeding project. After soil preparation, the areas were hydroseeded with mixtures of native hardwood and pine trees, shrubs and grass seeds. In hydroseeding, a water solution containing the seed mixture, fertilizer and mulch is sprayed onto the area being reclaimed.

The species and pounds of seed per acre were varied on each experimental site to determine the combination of seeds that will produce protecting ground cover and enough seedling trees to reestablish forestation. On plot 1, along with fescue, timothy and sericea lespedeza, loblolly pine, shortleaf pine, Virginia pine, shrub lespedeza and false indigo were seeded.

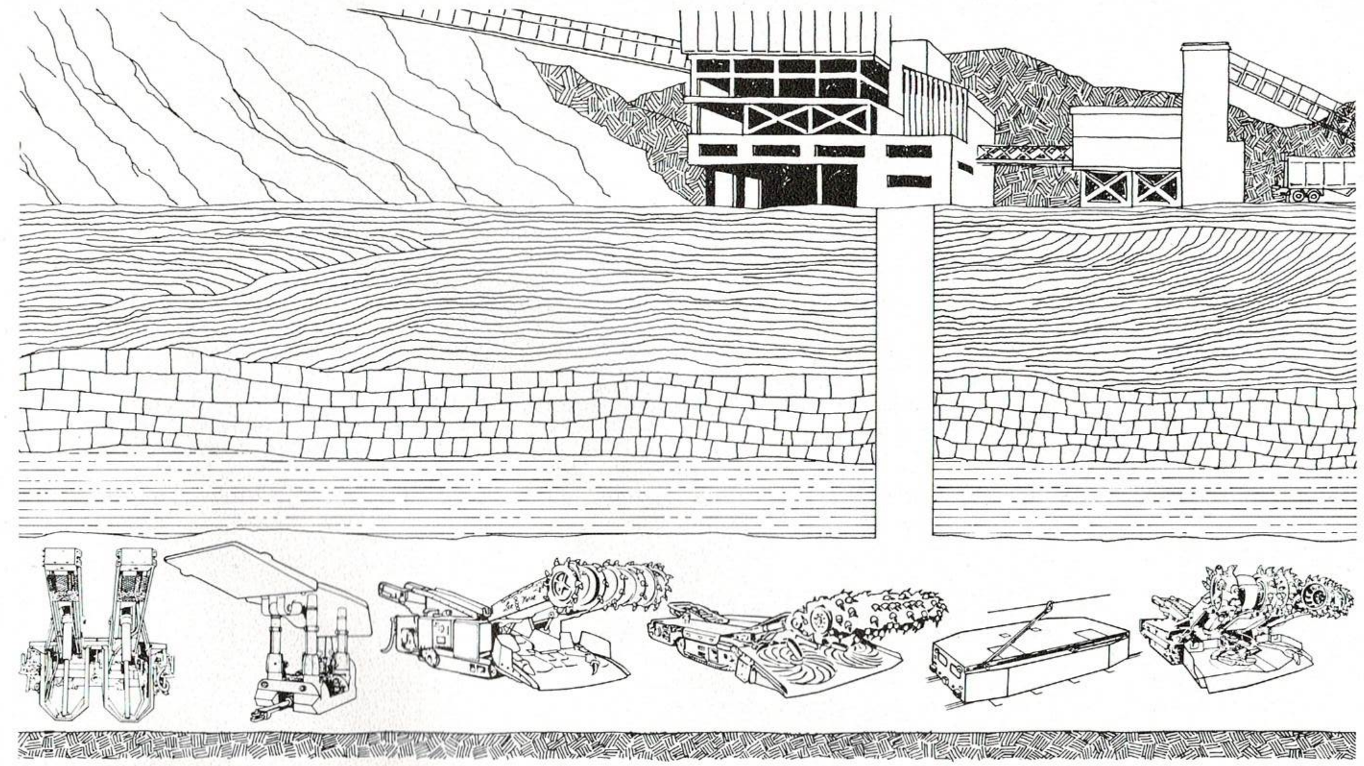
Land reclamation activities have continued to be an important part of U. S. Steel's coal mining operations. Since the Gary program began in 1948, more than 9,000 acres have been successfully reclaimed, and over 8,000 acres have been released by the West Virginia Division of Reclamation for having sufficient stands of vegetation.

During 1973, more than 25,000 pounds of tree and grass seeds, including black locust, bird's-foot trefoil, perennial ryegrass, weeping lovegrass and sericea lespedeza, were used for reclamation purposes. Several thousand shortleaf pine, white pine and autumn olive seedlings were also planted.



Employing direct seeding methods, the various grass, shrubs and tree mixtures will provide important information as to what seeds are best suited for reclaiming certain disturbed land. W. T. Plass, principal plant ecologist, U. S. Forest Service, Princeton, W. Va., prepares an experimental seed mixture at one of the project's test sites.

Carl Harmon, mobile equipment operator, hydraulically sprays a seed mixture on an experimental testing site. The district is cooperating with the U. S. Forest Service, Princeton, W. Va., in a program to develop additional information on revegetating surface-mined land.



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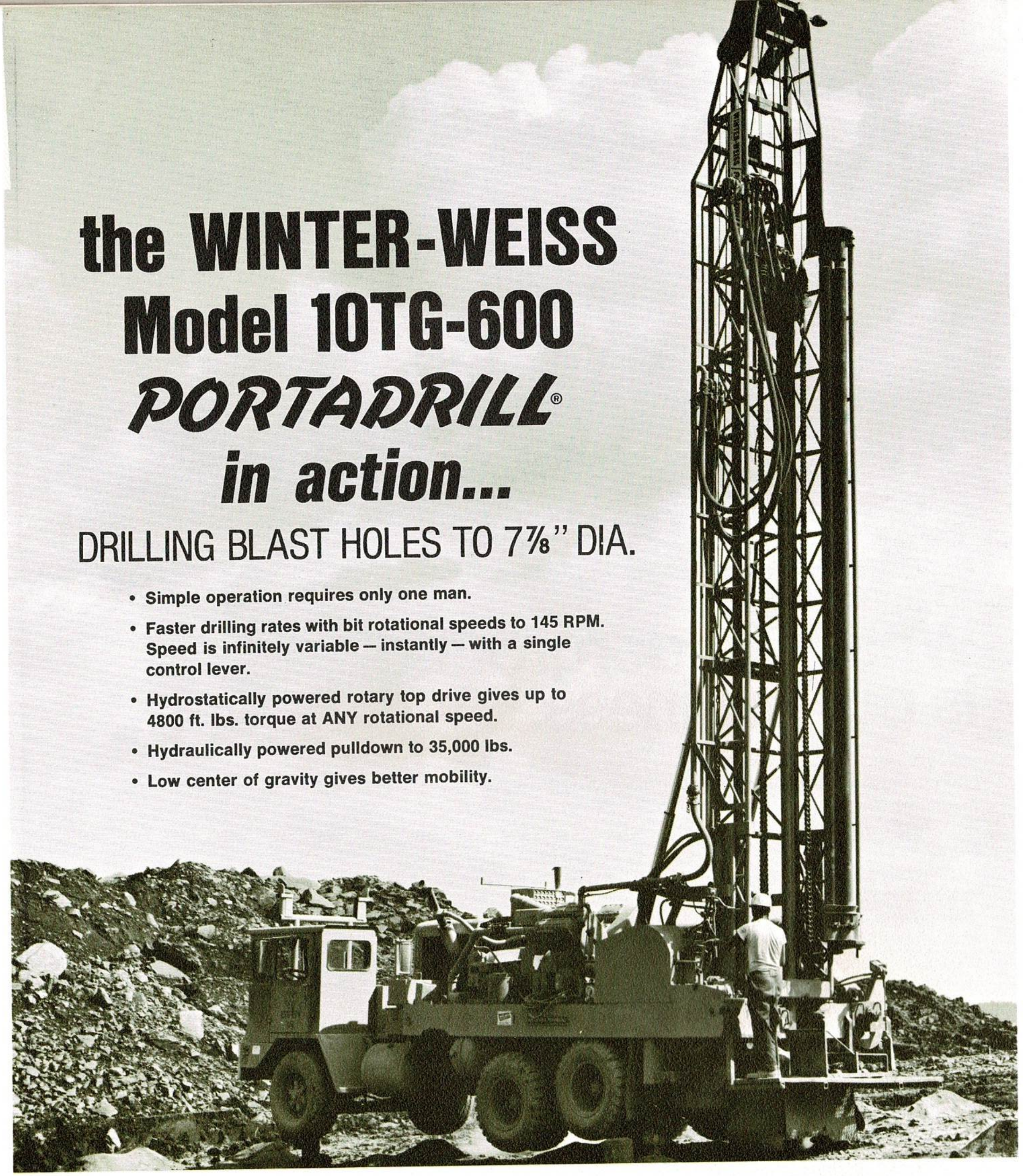

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MOUNTAINEER EXPERIMENT IS UNDER WAY

A Consolidation Coal Company research project aimed at finding an economical method of controlling water pollution from slate dumps is under way near the Williams Mine at Enterprise, Harrison County, West Virginia. This is a joint demonstration project between Consol's Environmental Quality Control Department and the Mountaineer Coal Division, attempting to establish a grass cover directly on highly acid refuse without the use of topsoil.

Shawn T. Sorrell, Consol's Environmental Quality Control Department agronomist, explained that the objective of the project is to determine the most economical method of providing lasting cover for the mine refuse disposal area. A major objective is to determine whether the area can be adequately neutralized to permit permanent vegetative growth, he said. If successful, similar seeding programs may be used in areas where topsoil is either unavailable or too costly, Sorrell said.

An inactive slurry impoundment had to be reclaimed to remove it as a potential safety hazard. Preparation plant refuse was used to provide a five to ten foot deep fill to eliminate the reservoir and to provide a gently sloping topography for adequate drainage and erosion control. Huge earth-moving equipment, including bulldozers and scrapers, was used to accomplish this phase of the project.

The grading operations were accomplished by Mountaineer Coal Company personnel and by a local contractor, under the direction of Don Born, Mountaineer Division's environmental engineer.

Samples of the coal refuse were then analyzed, using special soil analysis procedures to determine the quantities of limestone and fertilizer that would theoretically be needed to establish a permanent grass cover. Based on the laboratory analysis, agricultural limestone was applied to the 12-acre area and incorporated into the refuse to a depth of 8 inches by the use of a heavily weighted disk-plow, loaned by King Knob Coal Company.

A nitrogen fertilizer was then spread on the area, using conventional farm equipment. The grass seed mixture, consisting of Kentucky Tall Fescue and perennial Ryegrass, was broadcast on the area, using a cyclone seeder attached to the rear of a farm tractor. A legume, Birdsfoot Trefoil, was then applied with a hand cyclone seeder. The 12-acre area was mulched with hay and the area lightly disked.

After one month, Sorrell said, grass is already visible. Only time will provide the answer as to whether the grass "takes" and returns next year to cover the area, Sorrell said, adding that Consol's Environmental Quality Control Department will continue to monitor the project area.

The seeding and mulching operations were done by the West Fork and Tygarts Valley Soil Conservation Districts, under the coordination of Quentin Bennett, District Conservationist of the U. S. Soil Conservation Service in Clarksburg, West Virginia.

This is another example of Consol's new environmental ethic in combining modern science, technology and management in testing promising and innovative techniques for pollution control.

The Williams Mine is operated by Consol's Mountaineer Division, which has spent more than $700,000 for construction of waste water treatment plants the past five years. Four plants already are operating and a fifth is under construction.

BEFORE SEEDING ON JUNE 3, 1974

This is the site of Consolidation Coal Company's research project aimed at finding an economical method of controlling water pollution from slate dumps near Mountaineer Division's Williams Mine at Enterprise, Harrison County, W. Va.

AFTER SEEDING JULY, 1974

Officials inspect site of Consolidation Coal Company's newly seeded 12-acre area of highly acid mine refuse without the use of topsoil. Photo was taken approximately one month after a mixture of grasses had been broadcast on the area, mulched and disked. Pictured at the research site are (from left) Don Born, environmental engineer for Mountaineer Division; Quentin P. Bennett, district conservationist, U. S. Soil Conservation Service, Clarksburg, W. Va., and Shawn T. Sorrell, Consol's Environmental Quality Control Department agronomist.

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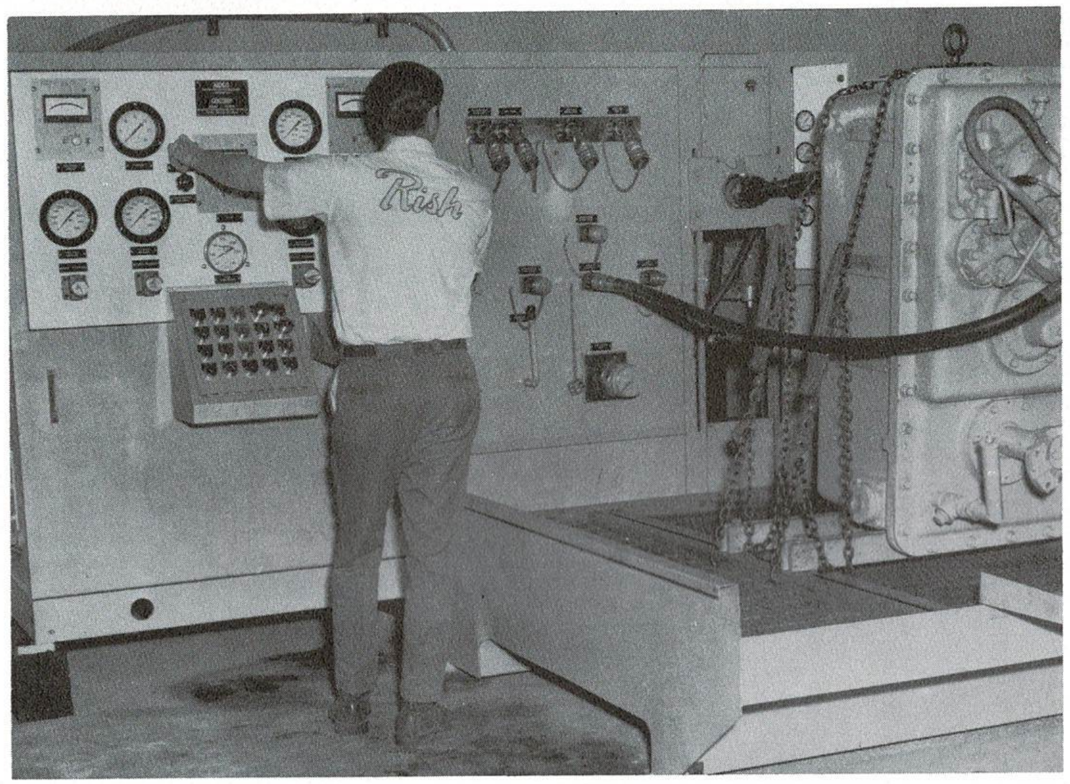

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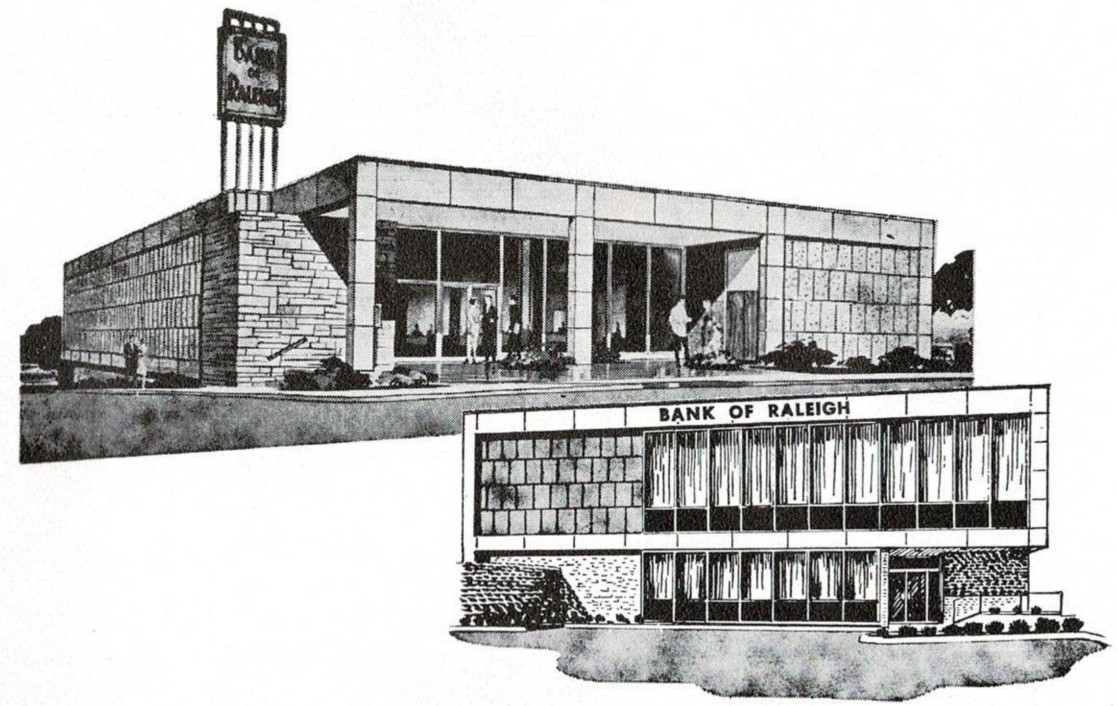

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CIVIL ENGINEER
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COAL NEEDED FOR EXPORT
We have been contacted by a buyer who is interested in obtaining 20,000 to 50,000 tons of steam coal per month for overseas export. Preferred BTU is 12.5, but should be as low as 12.1. Acceptable ash is 10 percent maximum and sulphur content must be under 1.75. F.O.B. east coast is preferred, but negotiable and price will reflect present market rates.
Anyone interested in further information, please contact this office.

COAL COMPANY WANTED
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1,000 ACRES AVAILABLE
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For further information, contact Ben Lusk at the Association office.

SURFACE MINE COAL AVAILABLE
Two sites for proposed surface mining are available in the Horseshoe Creek area of Fayette County. (1) 25 acres — Little Eagle Seam and the Gilbert Seam. (2) 35 acres of the Gilbert Seam only.
Anyone interested in further information on these two sites should contact this office.

Anyone interested in acquiring additional copies of **Green Lands Quarterly,** or receiving further information about membership in the West Virginia Surface Mining and Reclamation Association is encouraged to contact us at Suite 704, 1033 Quarrier St., Charleston, W. Va. 25301.

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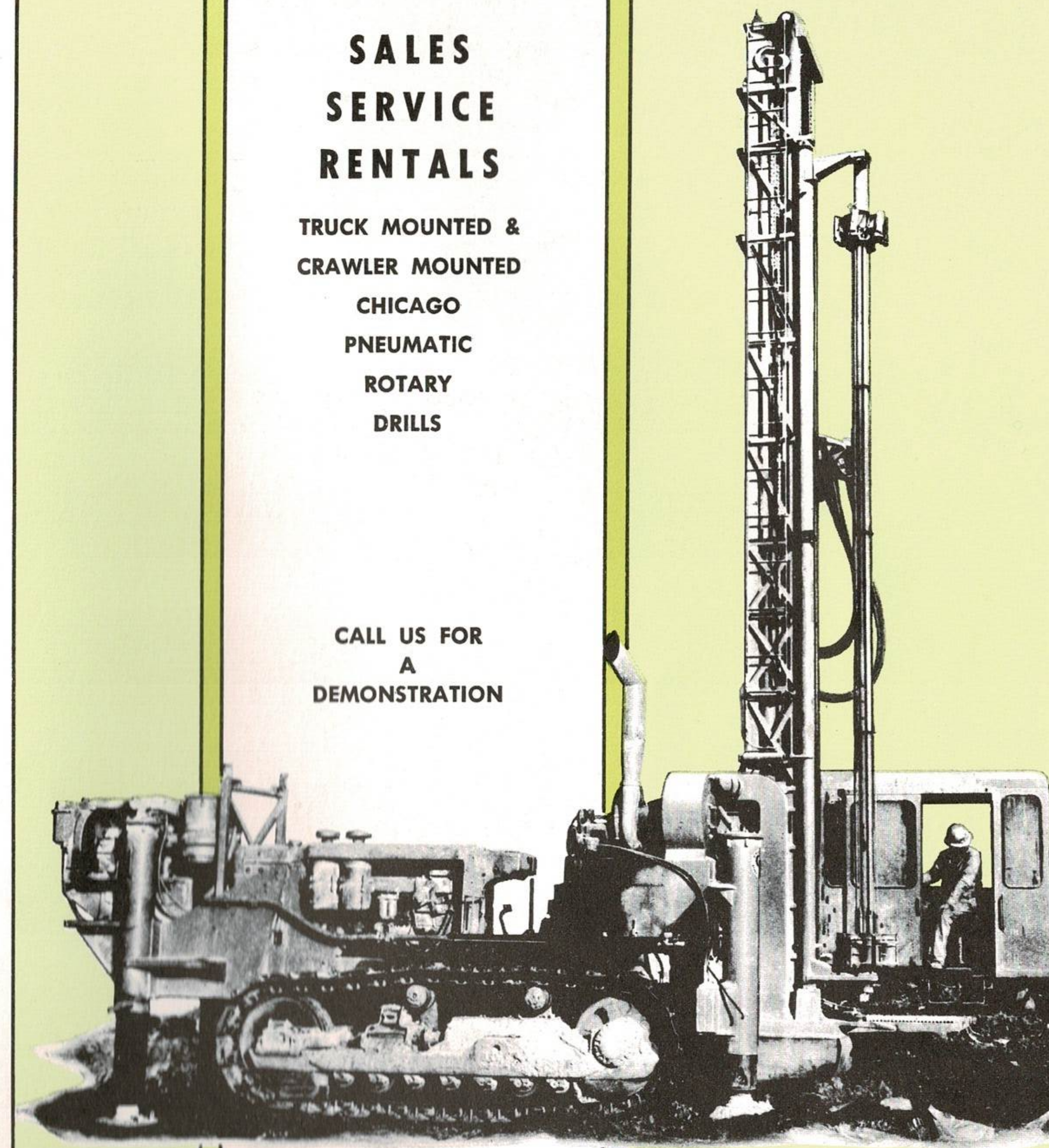

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