COMMONWEALTH OF VIRGINIA
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GROUND WATER IN PIEDMONT VIRGINIA

V. R. Geyer

The importance of water is seldom appreciated. Residents of cities have become so accustomed to getting water simply by turning a faucet handle that they rarely stop to consider the vital significance of this resource -- that it is a prime requisite for all living things. Few people realize that water, though replenishable, is not inexhaustible.

Demands for ground water in Piedmont Virginia, as in most other areas, have been growing rapidly. Air-conditioning equipment, new spin-type washing machines, refrigeration units, and irrigation systems require large amounts of water, and their introduction has resulted in a keen interest in ground water. This interest has been further stimulated in recent years by recurrent droughts. Many municipal water supplies and practically all rural water supplies in the Piedmont are derived from ground-water sources.

Virginia is divided into five physiographic provinces which, from east to west, are: (1) Coastal Plain; (2) Piedmont; (3) Blue Ridge; (4) Ridge and Valley; and (5) Appalachian Plateau (Fig. 1). In no two of these regions are ground-water conditions the same; they even differ considerably within each region.

The most important factors influencing the water-bearing properties of rocks are: (1) duration and intensity of precipitation; (2) permeability of the soil and rocks; (3) structural character of the rocks; (4) depth and degree of weathering; (5) topography and surface drainage; and (6) vegetative cover.

Ground water may be defined as water within the earth which fills the openings in rocks up to a level known as the water table. Ground water is part of an endless and complex cycle in which there is a vast circulation of water moving from the sea to the atmosphere, from the atmosphere to the land, and thence back to the sea (Fig. 2). After evaporation from the sea and the formation of clouds, moisture may be precipitated on the sea itself or upon the earth. Some of the rain falling upon the earth runs directly off into streams, part is evaporated, and part seeps into the land. Not all the water which goes into the land reaches the water table. Some is used by vegetation and released through transpiration.

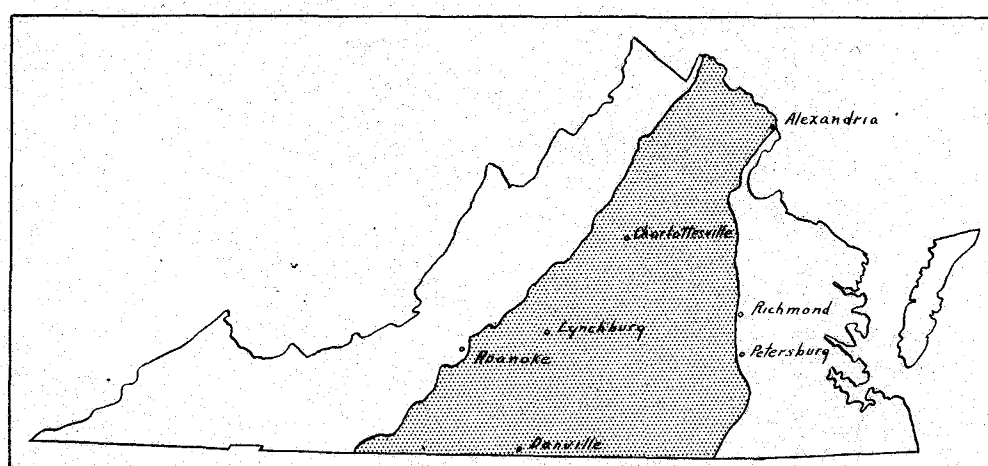
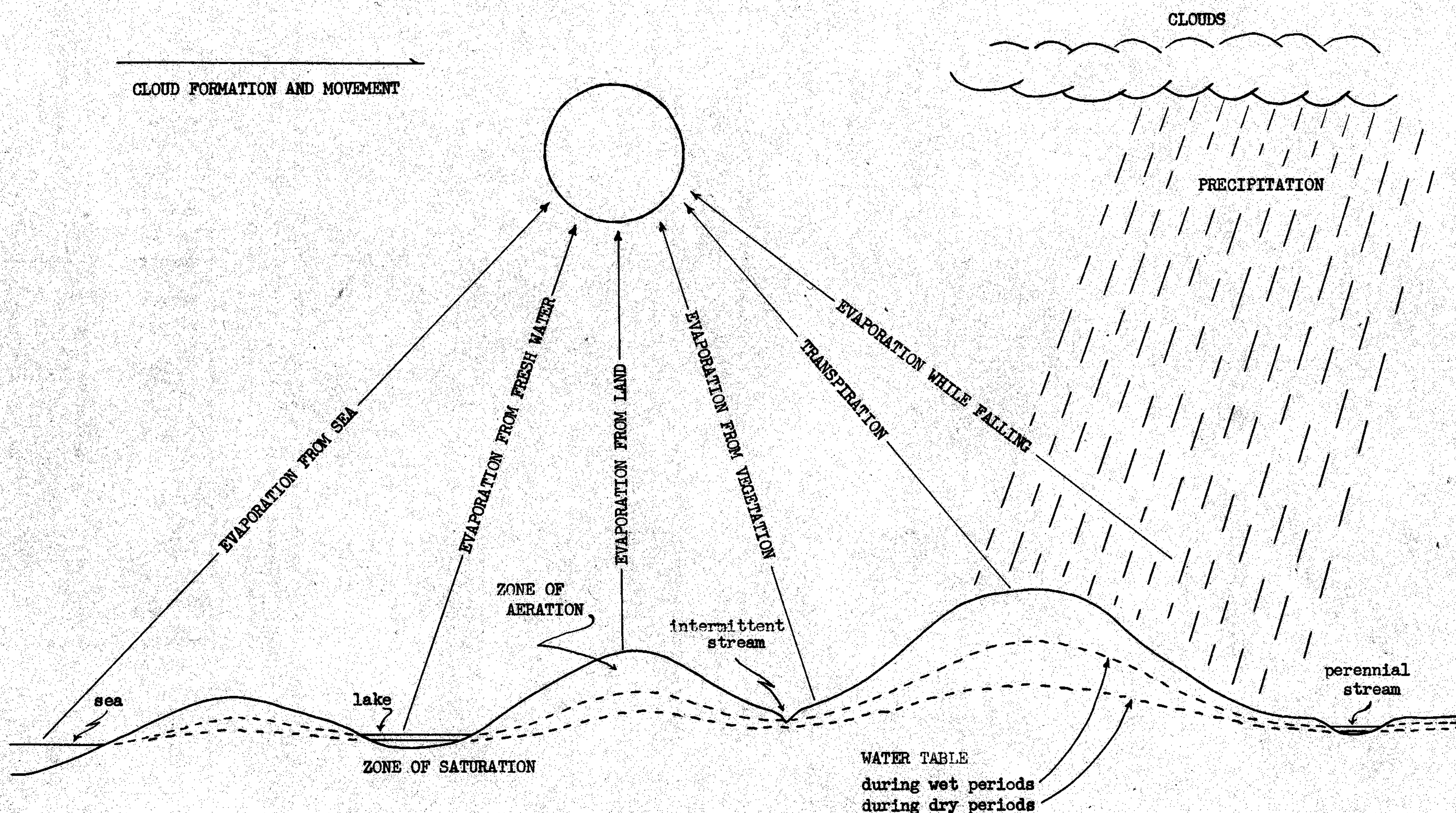


FIGURE 1

Index Map Showing Piedmont Virginia



F I G U R E 2

The Main Elements of the Hydrologic Cycle

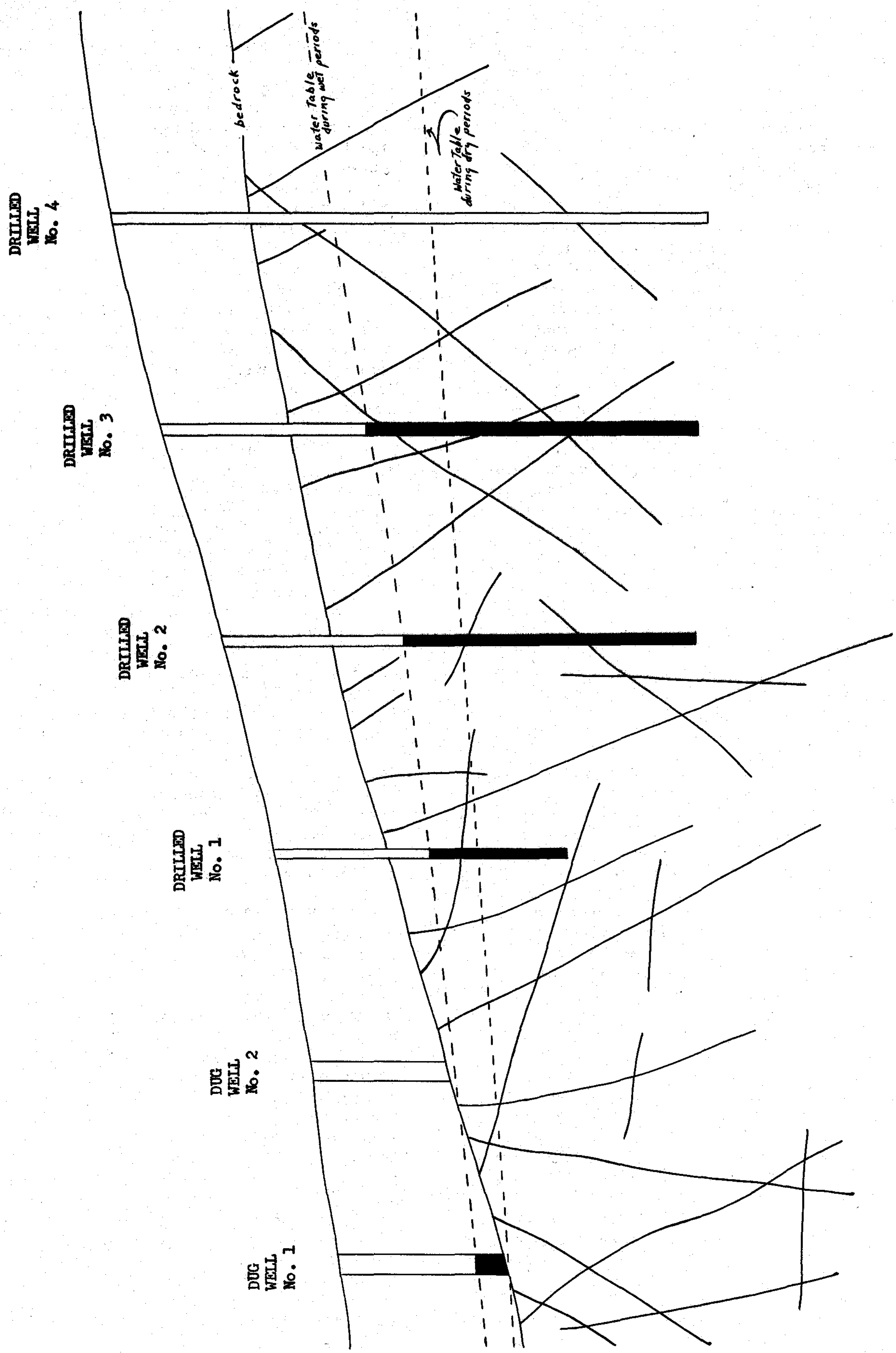


FIGURE 3

Diagrammatic Sketch Showing Results Obtained from Wells in Crystalline Rocks under Varying Conditions

Some is taken up in satisfying the soil moisture demands above the water table; this is achieved by surrounding the component grains of the rocks and soil with a thin film of water held in place by molecular force. Once this is accomplished, the remaining portion of the rainfall works its way downward through the rocks to an underground reservoir called the zone of saturation. The water table is the upper surface of this zone.

The water table is rarely a level surface but tends to conform with the land surface; consequently it is higher under hills than valleys, although under hills it is actually farther from the land surface than under valleys (Fig. 2). Differences in height of the water table cause water to move toward topographically low areas under the force of gravity. The water table does not remain static but rises and declines at a rate controlled largely by precipitation, rock permeability, topography and, in certain areas, by the discharge from wells. Even though the water table may fluctuate continuously, it tends to maintain an "average" level as long as there is no long-term trend in climate, large withdrawal from wells, or drastic change in the vegetative cover. The underground phase of the hydrologic cycle may aptly be called the slow motion phase; it brings about a more constant flow in streams throughout the year.

Essentially all ground water in the Piedmont is from rain or snow; probably none of it is derived from the interior of the earth (juvenile water). As the source of water in the province is precipitation, fluctuations of the water table are related to wet and dry periods. Annual precipitation in Piedmont Virginia averages about 42 inches; it is estimated that about two-thirds of this amount is lost by runoff and evapotranspiration (evaporation and transpiration). Approximately one-third of the rain and snow-melt percolates downward into the zone of saturation.

Practically all rocks in the Piedmont province are dense crystallines; very little pore space to store water is found between the component grains of these rocks. Therefore, the source of ground water in this region is other openings in the formations, such as joints, fractures, and solution channels. Because fractures found at the surface cannot always be projected downward with confidence, it is not certain where a given well will intersect them, if at all. The number and size of the openings usually decrease with depth and may vary considerably within a given rock type, as well as from one rock type to another. These rock fissures may be enlarged by weathering. Generally the quantity of water from any well drilled below the soil mantle present practically everywhere in the Piedmont will be dependent upon fissures or other openings encountered, whereas the chemical quality will reflect the composition of the rock in which the well is drilled.

The colder the temperature of rain water, the smaller the percentage which goes into the earth. This is because the viscosity of cold water is greater than that of warm water. Temperature also influences the rate of ground-water recharge when the ground is frozen, as it may be in Piedmont Virginia during part of the winter. There can be no movement of water through frozen ground, and so no rain or snow-melt reaches the water table in an area where the ground is frozen.

The behavior of ground water is more difficult to observe than that of other phases of the water cycle. However, much has been learned about it, and time, effort, and needless expense can be saved by making use of available information. Wells drilled at random or at locations chosen for convenience alone can be very expensive.

There are at present no geophysical instruments or "witching" devices with which one can predetermine how much water will be encountered at a given depth in crystalline rocks. It is known, however, that the average yield is considerably greater from wells drilled at carefully selected and geologically favorable locations than from wells drilled at sites selected for convenience only. To a limited extent, the drilling of any well in the Piedmont province is a gamble, but, fortunately, ample water supplies for domestic farm needs can be obtained almost everywhere. Analyses show that water from these wells is generally soft and seldom contains enough dissolved mineral matter to necessitate treatment. However, when a well is drilled with the hope of providing large quantities of water to meet the demands of industry, municipalities, or irrigation systems, favorable results cannot be assured and other means of securing a water supply should be seriously considered before seeking to develop ground water.

Figure 3 illustrates several of the conditions encountered in attempting to construct a well in the crystalline rocks of the Piedmont province. The well shown at the extreme left of the diagram, Dug Well No. 1, encountered water in the soil mantle overlying bedrock. Note, however, that during a prolonged drought the water table will decline to a point below the bottom of the well and at that time the well will be dry. Had the well been continued several feet into bedrock, it is probable that there would be some water in the well even during dry seasons. Dug Well No. 2 was not continued into bedrock, perhaps because of difficulty in digging. Since it did not reach the water table, it was a failure. Drilled Well No. 1 was continued for some distance into bedrock and ended appreciably below the water table. However, since the well is receiving water from a single fissure just below the wet season water table, it will not receive water when the water level falls in the drier months. This well should be drilled deeper, intersecting the water-bearing fractures directly below it. Drilled Well No. 2 encounters deep fissures and will probably yield ample supplies of water at all times. Drilled Well No. 3 intersects several interconnected fractures at depth and will have a relatively high yield during all seasons. Drilled Well No. 4 passes through dry fractures only; the fracture which it intersects well below the water table is dry, as it is not connected with the surface and has no means of being filled. Therefore, Drilled Well No. 4 is dry.

As the quantity of ground water that can be continuously withdrawn from wells is dependent upon the geologic and climatic conditions and as demands for ground water are increasing rapidly in many areas, there is growing need for the collection and compilation of ground-water data bearing on recharge and storage. Scientific evaluation of these data will aid in securing maximum results for minimum cost, especially in areas where large quantities of water are required.

Published ground-water reports and other pertinent data, such as well logs and chemical analyses of well and spring waters, collected during field and laboratory investigations are available at the office of the Virginia Division of Geology in Charlottesville. This information should be of assistance to those interested in the occurrence, development, and utilization of ground water in the state.

Selected References

Cady, R. C., Ground-water resources of northern Virginia: Va. Geol. Survey Bull. 50, 1938.

Ellis, E. E., A study of the occurrence of water in crystalline rocks, in Gregory, H. E., Underground water resources of Connecticut: U. S. Geol. Survey Water-Supply Paper 232, 1909.

Meinzer, O. E., The occurrence of ground water in the United States: U. S. Geol. Survey Water-Supply Paper 489, 1923.

------, Outline of ground-water hydrology: U. S. Geol. Survey Water-Supply Paper 494, 1923.

Mundorff, M. J., Geology and ground water in the Greensboro area, North Carolina: N. C. Dept. Cons. and Devel. Bull. 55, 1948.

------, Flood-plain deposits of North Carolina Piedmont and mountain streams as a possible source of ground-water supply: N. C. Dept. Cons. and Devel. Bull. 59, 1950.

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NEW BULLETIN

Bulletin 71 of the Virginia Division of Geology, "The Geology and Oil Resources of the Rose Hill District, Lee County, Virginia," by Ralph L. Miller and J. Osborn Fuller, has been printed and will be distributed in April. Bulletins 69 and 70 will not be available for some time.

PUBLICATIONS OF DIVISION OF GEOLOGY

Two mineral resources circulars, the first in a series of publications of the division, have been released since the issuance of the January number of VIRGINIA MINERALS. These circulars are "Iron in Virginia" by Edwin O. Gooch of the division, and "Summary of geology and ground-water resources of the Eastern Shore peninsula, Virginia: A preliminary report" by Allen Sinnott and G. Chase Tibbitts, Jr. of the United States Geological Survey. Mineral resources circulars may be obtained free upon request to the Division of Geology, Box 3667, University Station, Charlottesville, Virginia.

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FIELD CONFERENCE IN VIRGINIA

A geologic field conference in the Harrisonburg area, Virginia, is being jointly sponsored by the Appalachian Geological Society, the West Virginia Geological Survey, and the Virginia Division of Geology. The conference, scheduled for May 20-22, will stress the pre-Cambrian and lower Paleozoic stratigraphy of the region. Among those who will conduct parts of the discussion are B. N. Cooper, Virginia Polytechnic Institute, R. S. Edmundson and W. A. Nelson, University of Virginia, H. P. Woodward, Rutgers University, and R. S. Young, Virginia Division of Geology. For information about this conference address R. S. Young at the division office in Charlottesville.

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MINERAL ACTIVITIES

The manganese mine at Crimora, a few miles north of Waynesboro, has been reopened, a large new mill installed, and carload shipments of high grade ore have begun. This mine was once the largest producer of manganese in the United States.

Appalachian Sulphides, a subsidiary of Ventures Ltd., a Canadian firm, is undertaking mineral exploration in the Virgilina district of southern Virginia and northern North Carolina.

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ROTARY RIG IN VIRGINIA

A rotary drill, one of the few ever to be operated in Virginia, has been set up by United Fuel Gas Company of Charleston, W. Va., in the Bergton area of Rockingham County. This drill is being run by the Moran Drilling Company of Wichita Falls, Tex. This rig will use compressed air rather than the usual drilling mud to remove cuttings from the well.

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NATURAL GAS AND PETROLEUM IN VIRGINIA IN 1954

Drilling for natural gas continued in 1954 in Southwest Virginia. Test wells were drilled in Buchanan, Dickenson, and Wise counties in the Appalachian Plateaus section. Information gathered by the Division of Geology indicates that 17 wells were completed with commercial shows of natural gas, and 5 wells were abandoned as dry holes.

The productive gas wells range in depth from 2400 to 7000 feet, averaging around 4500 feet. Gas is encountered mainly in three "pay" horizons, Upper Mississippian sandstones, Middle Mississippian limestones, and Devonian shales. Reported open-flow tests of individual wells range from less than 200,000 to more than 8,000,000 cubic feet daily. It is estimated from available information that production of natural gas in Southwest Virginia during the year amounted to about 1 1/2 billion cubic feet.

One new well was drilled in the Rose Hill oil field in Lee County but was abandoned at 4000 feet as a dry hole on May 7. All of Virginia's 1954 oil production of about 6500 barrels came from the Rose Hill field.

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RECENT ARTICLES

Two articles to which staff members have contributed have appeared in leading national geologic journals since the last issue of VIRGINIA MINERALS. R. S. Young of the division was coauthor with R. S. Edmundson, University of Virginia, of "Oolitic Limestone in the Triassic of Virginia," published in the December 1954 issue of the Journal of Sedimentary Petrology. The March number of the Bulletin of the American Association of Petroleum Geologists includes an article by Young and W. T. Harnsberger entitled "Geology of Bergton Gas Field, Rockingham County, Virginia." Reprints of this latter paper will be available for free distribution about May 1.

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TRANSFER OF GROUND-WATER GEOLOGY

After May 1 the Division of Geology will no longer be the agency concerned with the ground-water problems of residents of Virginia. In a recent re-organization of the Department of Conservation and Development, the Division of Water Resources has been allocated the ground-water activities previously under the Division of Geology. Vernon R. Geyer, ground-water geologist and author of the lead article in this issue of VIRGINIA MINERALS, has been assigned to the Richmond office of the Division of Water Resources. All ground-water matters should after May 1 be referred to Room 8, The Capitol, Richmond 19, Va.

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TOPOGRAPHIC MAPS

Almost all Virginia has been mapped topographically, but many of the maps are not as accurate nor on as large a scale as is desirable. The Division of Geology maintains a complete file of topographic maps of the state which are still in print, and many which are out of print, including reprints and revisions of old maps. About 500 different topographic maps are available through the division at Box 3667, University Station, Charlottesville, Va. All but a few of these maps cost 20 cents each. An index to topographic mapping in Virginia may be obtained free upon application to the Map Information Service, U. S. Geological Survey, Washington 25, D. C.

Before publication of the final map an advance sheet, subject to correction, is printed and distributed by the U. S. Geological Survey to those most likely to catch errors or suggest changes. Advance sheets may be consulted at the office of the division.

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Edited by C. C. Fisher

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