COMMONWEALTH OF VIRGINIA
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Richmond, Virginia

DIVISION OF GEOLOGY
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VIRGINIA MINERALS

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A quarterly designed to acquaint the public with the mineral resources and activities of Virginia, and to furnish information on market quotations, new discoveries and developments, and pertinent publications. Distributed free upon request to the Division of Geology.

With this issue we inaugurate a new series of nontechnical publications of the Division of Geology. The aim of "Virginia Minerals" is to acquaint the people of the State with Virginia's present and potential mineral resources: their discovery and development, production and uses, and their importance to the economy of both the district in which they are found and the State as a whole. This number of "Virginia Minerals" presents a broad mineral survey. Later issues will discuss specific minerals or localities.

A SUMMARY OF VIRGINIA'S MINERAL RESOURCES

C. C. Fisher

Few of us think of Virginia as a mineral-producing state of importance, and yet since 1947 the annual value of Virginia's mineral production has been greater than $100,000,000. In 1952, the last year for which records are available, this value reached $165,000,000. Thus Virginia ranks about 20th among the 48 states in value of minerals produced. This compares with a ranking of 35th in area and 15th in population.

Before undertaking a discussion of Virginia minerals, it should be noted that many geologic generalities will be employed here. These are necessary for simplification and do not lead to great misrepresentation. Occasionally, exceptions to the broad statements will be cited.

What is a mineral? According to a common geologic definition, a mineral is a natural inorganic substance having, within natural limits, definite chemical and physical properties. Clearly then, coal and petroleum, for example, are not minerals, and yet they are considered among the mineral resources of a region. Limestone, which might contain varying amounts of magnesium or other constituents along with the calcium carbonate of which it is largely composed, is not a mineral either, but it is included in the mineral resources of an area. Keeping this background material in mind, let us consider the minerals of Virginia.

Many different minerals or other products classified as minerals contribute to the mineral production of Virginia. Some of these are metals, such as lead, zinc, iron, and manganese; others are nonmetals, such as coal, salt, and limestone. Each of these minerals, whether metallic or nonmetallic, is found only in environments conducive to its formation or accumulation. Thus certain minerals, particularly many of the metals, are most likely to occur in igneous rocks, that is, rocks which originally were molten. Certain other minerals, such as coal or petroleum, more typically occur in sedimentary rocks, those deposited by water, wind, or ice. Then there are minerals, talc and kyanite for example, which commonly are found in metamorphic rocks - rocks which have been altered by heat or pressure after their original deposition or emplacement.

Besides differences in occurrence in various kinds of rocks, there are other variations in the environment of occurrence. Some minerals are typically found in beach sands, others in beds of ancient streams. Certain minerals occur usually in igneous rocks of very large grain size, called pegmatites. And to further complicate the picture, many minerals have several different modes of occurrence, but usually one more common than the others.

This general restriction of a given mineral to one kind of rock or one environment is well illustrated in Virginia by the geographic localization of many of the commercial mineral deposits. The three main types of rock - igneous, metamorphic, and sedimentary - are not scattered indiscriminately throughout the state but rather are arranged in a fairly definite pattern. Thus in general, east of Richmond, in the area called the Coastal Plain, unconsolidated sedimentary rocks - sand, gravel, and clay - predominate. From Richmond west to the Blue Ridge (the Piedmont area), and in the Blue Ridge itself, are igneous and metamorphic rocks. West of the Blue Ridge, in the region geologists call the Appalachian Ridge and Valley province - generally speaking, the Valley of Virginia - are sedimentary rocks again, but different from the sediments of the Coastal Plain. Here the rocks are

mainly limestones, dolomites (limestone containing magnesium), shales, and sandstones. So as would be anticipated, in the Coastal Plain are found some of those minerals usually associated with unconsolidated sediments; in the Piedmont and Blue Ridge the mineral wealth is normally that of metamorphic and igneous rocks; and in the indurated sediments of the Valley are commercial deposits of both metals and nonmetals.

It must be realized that simply because a given mineral commonly occurs in coarse-grained igneous rocks, for example, it will not be found in every locality where there are such rocks. Further, even where a valuable mineral is found it may not be in large enough quantity, or pure enough, near enough a market, labor supply, or transportation facility to be profitably exploited.

So in order to find a commercial mineral deposit we must look in the right place in the right kind of rocks or depositional environment, and the deposit must be properly located geographically for economic development. It is desirable and often vital to have detailed information about all the mineral resources of the state, because it is impossible to predict when a mineral not used today, or a deposit too low in grade to be profitably worked now, may become valuable.

It may now seem that the likelihood of having all the necessary factors in proper combination is not great, and such is the case. Nonetheless, there are commercial deposits of many different minerals in Virginia. Some of these minerals will now be discussed briefly.

Virginia's main mineral resource, accounting for between 60 and 70 cents of every dollar of mineral production value, is coal. Since 1908, more than $1,500,000,000 worth of coal has been mined in the state. Of the approximately $165,000,000 value of minerals produced in Virginia in 1952, about $115,000,000 was contributed by coal.

Although there is some coal near Richmond and Farmville, and in the general region of Montgomery and Pulaski counties (the Valley fields), by far the majority of Virginia's coal resources are in the southwest corner of the state. The coal in this Southwest field is bituminous, not as high in carbon as the semianthracite found in the Valley fields. Virginia's coal reserves, over 95 per cent of which are in the Southwest field, are ample to last more than 500 years at the present rate of production. Clearly coal, with its ever-widening range of uses, is and will continue for some years to be the most valuable mineral resource of the state.

Limestone and dolomite, next to coal, constitute the main mineral asset of Virginia. The geologist calls a rock which is largely composed of calcium carbonate ($CaCO_3$) limestone, whereas dolomite is a closely related rock in which magnesium takes the place of some of the calcium. In the Valley of Virginia are to be found virtually unlimited quantities of both limestone and dolomite, in many places clearly exposed at the surface. Virginia has limestone and dolomite of appropriate quality for almost every need. The chemical industries, which use lime (CaO) extensively as a reagent, need limestone with more than 95 per cent calcium carbonate and low in insolubles. Much limestone of this quality occurs in the Valley, and Virginia is one of the main lime-producing states. The treatment of depleted soils with lime is being practiced more and more widely. Limestone is also used in building, as crushed stone for a variety of purposes, in glassworks, as a blast furnace flux, in water purification plants, and in many other ways. Marble, which is crystalline limestone, is found in several places in the state.

Such prosaic materials as sand, gravel, and clay are counted among the mineral resources of Virginia. All of these are common in the Coastal Plain and in localized areas elsewhere in the state. Sand, besides its commonplace uses, is quarried in Frederick County for use as a constituent in glass. Virginia apparently has little clay suitable for fine pottery, but there are in the Coastal Plain sizable deposits of brick clay.

Natural mineral raw materials such as marl (a mixture of clay and limestone) or limestone and shale are used by the important cement industry of the state. Virginia is in a good position with respect to the necessary raw materials for cement manufacture.

Pyrite and pyrrhotite, both sulfides of iron, are found in the Piedmont of Virginia and are mined for their sulfur content. Therefore, they are included in nonmetallic resources. Ore mined in Carroll County is shipped to Pulaski for processing. These sulfides are of great importance, for sulfur is perhaps the most vital of the chemical minerals. Sulfur is used mainly in heavy chemicals, fertilizer, insecticides, and pulp and paper. The sulfur used in heavy chemicals is largely converted into sulfuric acid, which finds application in fertilizers, oil refining, chemicals, rayon, film, paint, and pigments.

Virginia contains many other minerals which, although mostly of less dollar value, are of importance to the economy of the local area in which they are found. These include soapstone and talc, kyanite, mica, feldspar, aplite, salt, and gypsum. Soapstone, which is composed mainly of talc but contains other minerals too, is quarried in Albemarle and Nelson counties. Virginia has one of the largest commercial deposits of soapstone in the world. Soapstone in blocks is used in the smelting furnaces of kraft paper mills and for equipment where acidproofing is important. Talc is found in the Piedmont in commercial quantity in several places. Talc, and ground soapstone as well, is used in paint, ceramics, insecticides, rubber, roofing, and paper.

Kyanite, an aluminum silicate, is mined in Prince Edward County and is used in the manufacture of porcelain for some types of glass and for spark plugs. Virginia leads the nation in kyanite production. Mica is found in particular in the southern Piedmont region. It is used mainly as an insulator in electrical equipment. Also in the southern Piedmont are commercial deposits of feldspar, an aluminum silicate which is used by the glass and ceramic industries because of its alumina content. Aplite, too, is used by the glass manufacturer because it is a rock which is high in alumina. There is a large aplite quarry in Amherst County, and another nearby in Nelson County.

Virginia's only commercial deposits of salt and gypsum, minerals formed by evaporation of sea water, are in Smyth and Washington counties. Salt is an invaluable mineral to the chemical industry and is used in various forms in many other industries.

Most gypsum, hydrous calcium sulphate, is used for building purposes, particularly in various kinds of laths, in wallboard, plasters, and cements.

Although production is small, Virginia does produce some petroleum and natural gas, largely in the southwestern and western parts of the state.

Two other mineral resources, although not commonly thought of as such, are ground water and soil. Their value is inestimable. Just as with the other mineral resources, they are not found everywhere, and even where found may not be of proper quality to be useful.

Thus far only the nonmetallic mineral resources of Virginia have been considered. The nonmetallics contribute considerably more than 90 per cent of the mineral dollar of Virginia, but nevertheless there are some valuable metallic deposits in the state. These will now be briefly mentioned.

Virginia has large deposits of zinc and lead. Easily the largest developed metallic resource in the state is the zinc and lead deposit near Austinville in Wythe County. The occurrence together of these two metals is very common, even though they are not chemically similar. In Virginia zinc is the more important, with lead being recovered as a by-product. The chief uses of zinc are in galvanizing, die castings, brass making, and rolled zinc for various purposes. Lead has a wide variety of uses, particularly as pigment in paint and flint glass, as cable covering, in storage batteries, and in tetraethyl lead.

The presence of iron ore in Virginia has been known for centuries. Once iron was mined in large quantities in the state, but with the development of large deposits elsewhere, Virginia production is now small. Nonetheless, there is a sizable amount of iron ore in the state, which with the depletion of high-grade ores from other localities may again assume considerable economic importance. The main deposits of iron ore in Virginia are found in the region west of the Blue Ridge, although there are scattered deposits throughout the state except in the Coastal Plain.

Two additional metallic resources of Virginia should be mentioned. Neither of these metals is perhaps as familiar as lead or zinc or iron, but each is of the utmost importance to a modern industrial economy. These are titanium and manganese. Titanium is extracted from the minerals ilmenite (iron plus titanium plus oxygen) and rutile (titanium plus oxygen). For many years most of the world's rutile supply was obtained near Roseland in Nelson County. Ilmenite has been mined in Virginia along Piney River, in Amherst and Nelson counties. Other Virginia counties also have titanium ores.

The potential importance of Virginia's titanium is hard to exaggerate. Titanium is one of the most strategically necessary of all metals, yet the United States imports almost all the titanium consumed domestically. Titanium is sometimes spoken of as the new wonder metal. In various forms it has been used for years, as a pigment in paint (making the whitest paint known), as a ferrocarbon titanium alloy with steel (making the high-speed steels so desirable today), and in the form of titanium tetrachloride, in sky-writing. It is only recently, however, that metallic titanium has been produced in commercial quantities, and its properties as a metal are such as to make it an unusually useful material. It is light, strong, and extremely resistant to heat and corrosion. Titanium is thus an ideal material for jet aircraft.

Manganese, another metal found in Virginia, is the most important of all the ferroalloys - those metals which are used for alloying with iron to yield steels of certain specific properties. Manganese is absolutely essential to the making of all carbon steel, about 13 pounds of it being needed per ton of steel produced. Manganese steel is used where hardness and toughness are desired. Inasmuch as the Soviet Union produces about half the world's total supply, and the United States is not rich in manganese, the potentiality of the Virginia deposits is of much interest. Deposits of manganese are known in many parts of the state, and Virginia could possibly supply large quantities of low-grade manganese ore.

It is evident, then, that Virginia has great wealth in mineral resources, particularly in the nonmetals but also in some highly strategic metals. The above discussion is not by any means exhaustive, and continued search will no doubt disclose other deposits of minerals, of either immediate or potential value. New research and extraction techniques may lend value to minerals which today are of little commercial importance.

It is of vital importance to the future of Virginia that the location, extent, chemical composition, physical characteristics, recoverability -- in fact, all possible details - should be known for all mineral deposits in the state.

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*No longer available.

NEW MAPS AND PUBLICATIONS

Each future issue of "Virginia Minerals" will include information on new maps of Virginia and pertinent new literature published since the last number of the quarterly. Such material will usually be accompanied by a brief description of the map or discussion of the article.

STAFF ACTIVITIES

With disconcerting frequency geologists are asked just what they do. The members of the division staff in Charlottesville are no different from their fellows in this respect. Clearly there is misunderstanding as to the function of a Division of Geology and its contributions to the public.

A wide variety of activities make up a typical work week at the Division of Geology. Among the most important parts of the normal schedule are office and field conferences with representatives of industries or with private individuals to discuss the economic possibilities of specific mineral deposits or the general likelihood of finding new mineral deposits. Members of the staffs of the U. S. Bureau of Mines and the U. S. Geological Survey are frequently in contact with the division to consider cooperative or independent projects, or to exchange information and ideas.

Surprisingly, perhaps, many conferences are held with persons not associated with any mineral industry. These discussions concern the acquisition of an assured supply of one of the most important of all minerals - ground water. Many towns and farms depend on water which is drawn from wells or springs. The location of an industrial plant is often determined in large part by the availability of ground water. Thus ground water conferences and investigations are a vital part of the division's activities.

These discussions with staff members may result in the location of new industries in Virginia, the expansion of present industries, or new geologic explorations.

Each week, by mail or by personal inquiry at the office in Charlottesville, numerous rock specimens collected in Virginia are brought to the attention of division geologists. After identification of the samples, a report is sent to the collector. This public service of the division is available to all. The division also sends out, on request, specimens of minerals and rocks from Virginia.

Much office time is devoted to writing up material collected in field work. Such information, after formulation, either becomes an unpublished memorandum report, a division publication, or an article in one of the national geologic journals.

Field activities of the geologists of the division are a diverse as is geology itself. Geologic mapping, ground-water investigation, stratigraphic study, faunal collection, landscape analysis - these are only a few of the many types of work performed in the field.

At the present time staff members are working on these special projects, among others: mineral resources circulars on iron and titanium, a bulletin in the Edinburg quadrangle (mainly in Shenandoah County), a report on the metasedimentary rocks in the Laurel Mills-Batesville district of the north-central Piedmont, a report on the gas possibilities of the Bergton area in Rockingham County, and an exhibit for the Atlantic Rural Exposition.

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VISITING GEOLOGIST

Professor Charles M. Nevin of Cornell University, author of "Structural Geology," a standard text, was in Virginia for a week during August as a consultant on field work sponsored by the division. Professor Nevin spent some time in Charlottesville at the division office, inspecting the facilities and discussing present and future programs.

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FORTHCOMING PUBLICATIONS

Two important new publications on the geology of Virginia are in press, and will be available for distribution in the near future. The first of these, by Ralph L. Miller and J. Osborn Fuller, is entitled "The Geology and Oil Possibilities of the Rose Hill District, Lee County, Virginia." It will be bulletin 71 of the Division of Geology. The other new publication, by Ralph L. Miller and Steve Brosges, to be published as bulletin 990 of the United States Geological Survey, will deal with the geology and oil possibilities of the Jonesville district, also in Lee County.

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DIVISION LIBRARY

At the headquarters building in Charlottesville the Division of Geology maintains a small reference library, under the supervision of a part-time librarian. The division library subscribes to all the major national journals dealing with geology and related sciences, as well as to those periodicals of more specific interest to workers in Virginia. One section of the library is devoted to publications issued by the geologic divisions of other states, another section to a fairly comprehensive collection of the many papers distributed by the U. S. Geological Survey and the U. S. Bureau of Mines. Geologic literature from foreign countries is represented by a small carefully chosen selection. The library also includes a limited number of texts and reference books.

Although the division library is designed primarily for the reference use of the division staff, the general public is welcome at any time to make use of the facilities.

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RECENT PUBLICATIONS ON VIRGINIA MINERALS

Two recent publications by Richard V. Dietrich, Associate Professor of Geology at Virginia Polytechnic Institute, are of particular interest to the general reader. "Virginia Mineral Localities," published in September 1953 as Virginia Engineering Experiment Station Series No. 88, details the counties in which specific minerals have been found. "Virginia Minerals and Rocks," Engineering Experiment Station Series No. 90, January 1954, is of unusual value to those interested in learning the fundamentals of rock and mineral lore. Both of these papers may be obtained by writing to the Virginia Engineering Experiment Station at Blacksburg. The price of the first is 50 cents, of the second 75 cents.

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SUMMER FIELD WORK

As in the past, the Division of Geology has this summer sponsored the field work of several geologists who are not permanent members of the staff. William B. Brent, Cornell University, spent the summer working on the geology and mineral resources of the Harrisonburg quadrangle. Engaged in field studies in the Piedmont were William R. [illegible], University of Kentucky, and Harvey C. Sunderman, University of Cincinnati, working in the Dillwyn and Covesville quadrangles, respectively. After these men have completed their investigations, the results will be released as bulletins of the division.

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NEW MAPS

Five new topographic maps have been received at the division office in the last few months. Two of these, made by the Corps of Engineers, on a scale of 1:24000 and with a contour interval of 20 feet, are of the Yorktown, Va., and Seneca, Md.-Va., 7½ minute quadrangles. These may be purchased, for 20 cents each, through either the Division of Geology or the U. S. Geological Survey, Washington 25, D. C. The other three maps, on a scale of 1:250000, are part of the Army Map Service coverage of the United States. These are designated Greensboro, Norfolk, and Winston-Salem, and include parts of Virginia and North Carolina. Each map takes its name from the largest city in the area. These may be obtained from the Division of Geology, Charlottesville, or the Washington Distribution Section, U. S. Geological Survey, Washington 25, D. C. The price is 50 cents each.

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NEW SERIES OF PUBLICATIONS

Two new series of publications of the Division of Geology will appear soon. These are designed to meet the increasing demand for more information about the minerals of Virginia and the functions of the Division of Geology. The first of these, consisting of mineral resources circulars, will deal in detail with specific individual minerals of Virginia. Iron, titanium, and manganese will be the subjects of early numbers. The other new series, to be called information circulars, will be the medium for publishing bibliographies, mineral statistics, lists of division publications, and other material of general interest.

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EXPLORATION NEWS

The Attorney General on behalf of the Commonwealth of Virginia has granted a prospecting mineral lease and permit to Sidney S. Alderman, Jr. of Baltimore. This permit authorizes Mr. Alderman to conduct drilling activities for ilmenite, zirconium, and other minerals on the bed of Chesapeake Bay.

Considerable prospecting for manganese has been undertaken in recent months. Most of this activity has taken place in Bland, Frederick, Giles, and Smyth counties.

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SECOND BIGGEST WELL IN PIEDMONT COMPLETED

We have just learned that the second biggest water well in the Piedmont of Virginia was completed in September for the city of Culpeper. This 8-inch well is 709 feet deep, with a static level at 13 feet. The largest source is at 556 feet. A test pumping of 360 gallons per minute for 34 hours and 420 gpm for 1 hour (with 35 feet of drawdown at the larger figure) has shown a minimum yield of 360 gpm. This yield is exceeded in the Piedmont of Virginia only by a well at Warrenton, and compares with an average of about 10 gpm for wells drilled in the Piedmont and less than 2 gpm for wells dug. The new well is to be pumped at a rate of 300 gpm. Both the Culpeper and Warrenton sites were recommended by the division's ground-water geologist.

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SELECTED DIVISION PUBLICATIONS

The following is a partial list of available division publications. Unless a price is shown the item is free upon application. Checks and money orders should be made payable to the Division of Geology.

Bulletins

52 - Geology of the Appalachian Valley in Virginia, by Charles Butts, 1941. Price: $1.50.
53 - Barite deposits of Virginia, by R. S. Edmundson, 1938.
54 - Geology and mineral resources of the Warrenton quadrangle, Virginia, by A. S. Furcron, 1939.
55 - Geology of the Draper Mountain area, Virginia, by B. N. Cooper, 1939.
56 - The Early Grove gas field, Scott and Washington counties, Virginia, by Paul Averitt, 1941. Price: $1.00.
57 - Eocene of Virginia, by Benjamin Gildersleeve, 1942.
58 - Chloride in ground water in the Coastal Plain of Virginia, by D. J. Cederstrom, 1948.
59 - Manganese and quartzite deposits in the Lick Mountain district, Wythe County, Virginia, by F. W. Stead and G. W. Stose, 1944.
60 - Geology and mineral resources of the Burkes Garden quadrangle, Virginia, by B. N. Cooper, 1945. Price: 25 cents.
61 - Geology and manganese deposits of the Glade Mountain district, Virginia, by R. L. Miller, 1945. Price: 25 cents.
62 - Industrial limestones and dolomites in Virginia: New River-Roanoke River district, by B. N. Cooper, 1945.
63 - Geology and ground-water resources of the Coastal Plain in southeastern Virginia, by D. J. Cederstrom, 1946.
64 - Commercial granites and other crystalline rocks in Virginia, by Edward Steidtmann, 1945.
65 - Industrial limestones and dolomites in Virginia: northern and central parts of Shenandoah Valley, by R. S. Edmundson, 1945.
66 - Industrial limestones and dolomites in Virginia: Clinch Valley district, by B. N. Cooper, 1951.
67 - An Upper Eocene foraminiferal fauna from deep wells in York County, Virginia, by J. A. Cushman and D. J. Cederstrom, 1949.
68 - Chemical character of ground water in the Coastal Plain of Virginia, by D. J. Cederstrom, 1951.

Reprint Series

16 - Structural framework and mineral resources of the Virginia Piedmont, by William R. Brown, 1954.

Maps

Outline map of Virginia showing counties and location of county seats. Scale, 1:2,000,000, or 1 inch equals about 32 miles; size 9 x 17 inches. Chiefly for use in the schools of Virginia. Free to teachers.

Geologic map of the Appalachian Valley in Virginia, by Charles Butts, 1933. (In colors.) Scale, 1:250,000, or 1 inch equals about 4 miles; size 43 x 63 inches. This map includes all of the State west of the Blue Ridge province. (From Bulletin 42.) Price: $1.00.

Geologic map of the Early Grove gas field, by Paul Averitt, 1941. (In colors.) Scale, 1:24,000, or 1 inch equals about four-tenths of a mile; size, 36 x 55 inches. Includes parts of Scott and Washington counties. (From Bulletin 56.) Price: 25 cents.

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