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VERMICULITE

Edwin O. Gooch

Vermiculite is a hydrated magnesium-iron-aluminum silicate that expands when heated. It has a characteristic micaceous structure and readily splits into thin laminae which are soft, pliable and inelastic. Its chief colors are amber, bronze, black, dark green, and reddish brown. The most distinguishing feature of vermiculite is its ability to expand when heated.

Expansion is thought to be the mechanical separation of the laminae when the contained water is converted into steam. Expansion usually takes place, in a matter of seconds, at between 1600° and 2000° F. When expanded, the volume may increase from 6 to 20 times (see Plates 1 and 2). The color usually changes to a silvery or golden hue, depending upon the nature of the material, the degree of heating, and the condition of exposure to air.

Because of its unique property of expanding when heated, the uses of vermiculite have developed rather rapidly in recent years. Although vermiculite was discovered in 1824 and its expanding properties then described, it was not until 1915 that expanded vermiculite was first marketed from a small deposit near Hecla, Colorado. This operation was very brief and not until 1921 did successful and continuous production begin, this time in Montana. Since 1921 the commercial utilization of vermiculite has developed rapidly and in 1951 represented a 15-million-dollar-a-year industry.

Marketing and Uses

Most of the companies that produce and market vermiculite concentrates also have expanding plants and thus produce and market expanded vermiculite. However, there are many companies that buy vermiculite concentrates

and manufacture expanded products. The manufacturer of expanded vermiculite products sells through jobbers and dealers, and occasionally contractors.

Because of its insulating and fire-proofing qualities, light weight, and granular form, expanded vermiculite is a very useful material. The principal uses are primarily based on one or more of these properties. The larger expanded granules are used extensively for insulation. Medium-sized granules are used in concrete and plaster aggregate. Plaster made with vermiculite aggregate is extremely fire-proof, almost crack resistant, and has insulating and sound-proofing qualities. Vermiculite aggregate is used in cement to form a light-weight insulating concrete. Vermiculite concrete is used for roof and floor insulation, and is precast into blocks and tiles for a variety of fireproofing, insulating, and dead-weight-saving purposes. Over a period of more than 20 years, vermiculite has proved to be free from the danger of delayed chemical reaction or volumetric expansion, resulting in a growing demand for vermiculite products in the building industry.

Expanded vermiculite is also used in horticultural work, where its properties of holding air and water make it useful for root development and for starting seeds and cuttings. Additional uses include the making of insulating refractory bricks and blocks, insulating plastics, pipe lagging, roof-insulation blocks, and other products.

Distribution

Vermiculite deposits have been reported from most parts of the world, and although it is still a relatively new material commercially, when it becomes better known, many more

VERMICULITE DISTRICTS IN VIRGINIA

- 1. LOUISIA COUNTY DISTRICT
- 2. BUCKINGHAM COUNTY DISTRICT
- 3. BEDFORD-FRANKLIN COUNTIES DISTRICT
- 4. PITTSYLVANIA-FRANKLIN COUNTIES DISTRICT
- 5. HENRY COUNTY DISTRICT
- 6. CHARLOTTE-HALIFAX COUNTIES DISTRICT

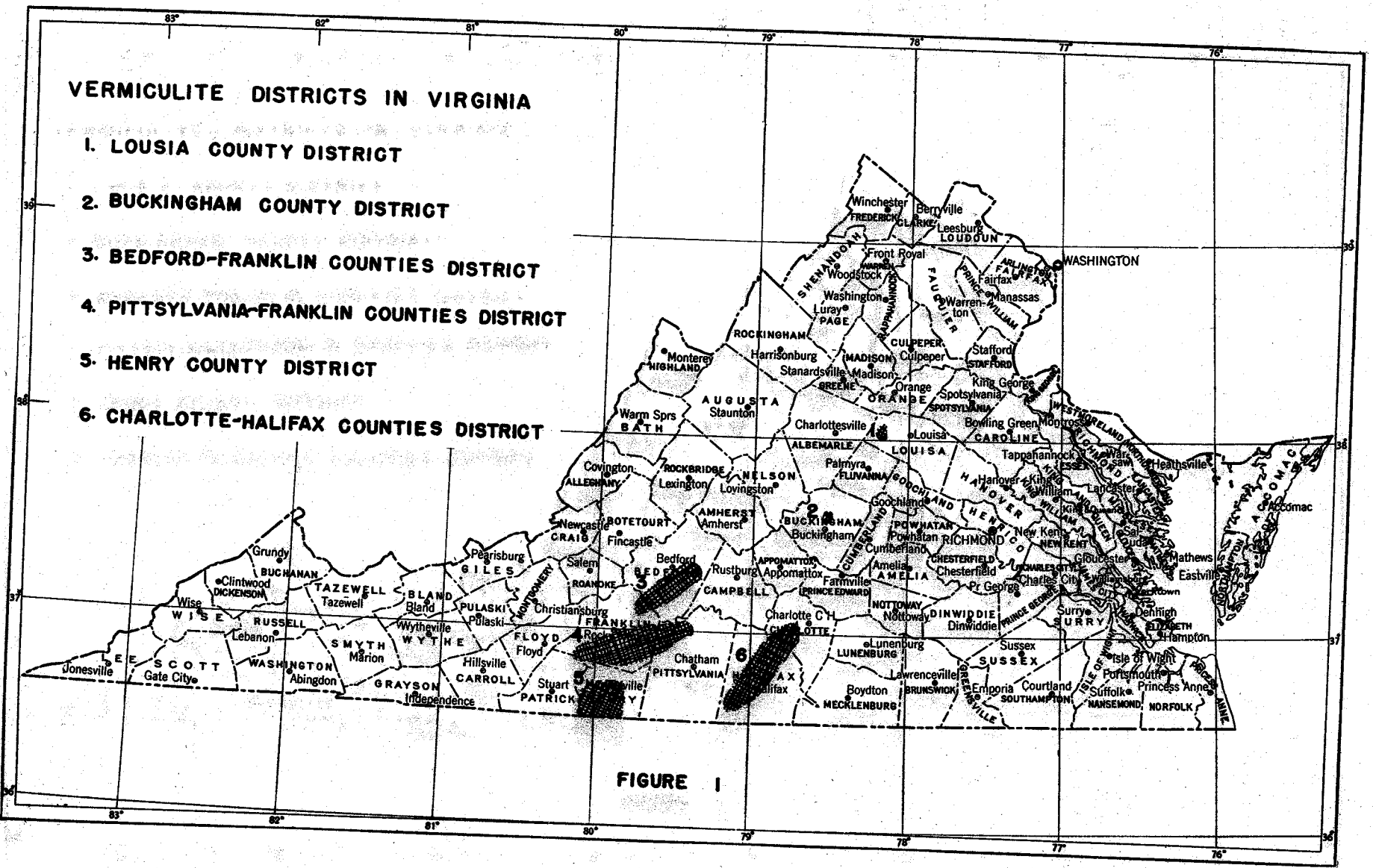


FIGURE 1

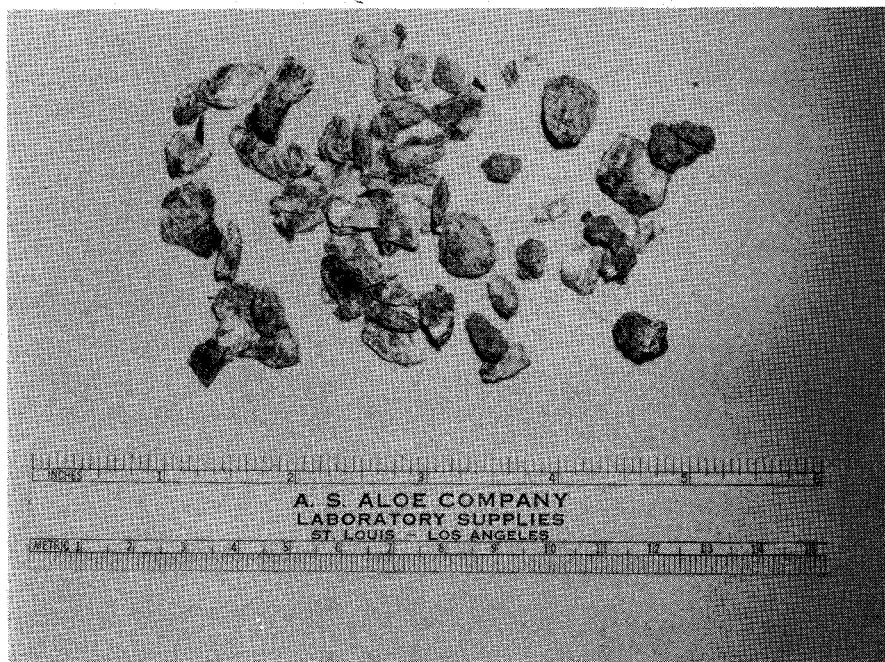


Plate 1. Crude vermiculite before expansion.

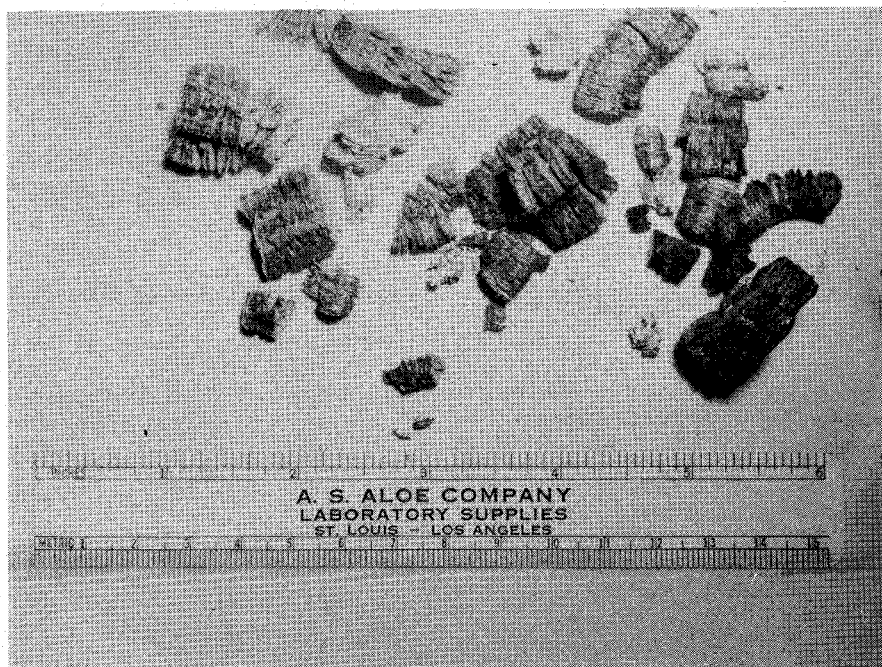


Plate 2. Vermiculite after expansion in muffle furnace for 2 minutes at 1650°-1850° F.

deposits will be found.

In the United States vermiculite deposits are known to occur in Arizona, California, Colorado, Georgia, Montana, Nevada, New Mexico, North Carolina, Pennsylvania, South Carolina, Texas, Virginia, and Wyoming. At present the principal producing states are Colorado, Montana, North Carolina, South Carolina, and Wyoming, with Montana and South Carolina being the main producers.

Until recently foreign production has remained small. Most of this production has been from the Union of South Africa, which started production in an experimental way in 1938. Today there are at least three producing companies in South Africa, mostly in northern Transvaal. Australia, Brazil, and Chile also produce some vermiculite, mostly for domestic use.

According to the February 1956 issue of Engineering and Mining Journal, the 1956 world production of vermiculite was expected to increase substantially over that for previous years, particularly because of growing demands in the building industry, where gun-applied vermiculite-gypsum plaster is replacing dry-wall construction, and in lightweight fire-proofing and insulating concrete. A number of new uses now in the development stage are also expected to further increase the demand.

Origin of Vermiculite

Undoubtedly, vermiculite originates in several different ways. In a deposit near Tigerville, South Carolina, vermiculite is thought to be the result of the alteration of biotite to vermiculite by the action of meteoric waters. This opinion is based on (1) the gradual increase in firmness and darkening of the vermiculite from the surface downward and towards masses of biotite, (2) the absence of biotite at the surface and its presence at moderate depth (10 to 15 feet), and (3) the presence of residual masses of biotite surrounded by vermiculite which has later developed along joints and slippage planes.

The large deposits near Libby, Montana, are thought to result from hydrothermal alteration of pyroxenites. Some deposits in North Carolina are considered to have been formed by the hydration and alteration of chlorite. In South Africa vermiculite is regarded as an alteration product of phlogopite. It appears likely, therefore, that vermiculite is formed by several geologic processes. Whatever the origin, vermiculite is found associated with basic and ultrabasic rocks.

Prospecting and Exploration

Because vermiculite is associated with basic and ultrabasic rocks, any area that is underlain by such rocks is a potential source of vermiculite, especially if the area contains pegmatites. Prospectors in the southeastern

states have used such clues with considerable success.

The best places to prospect for vermiculite are in road cuts, and in gullies, since vermiculite does not outcrop prominently. The first evidence is likely to be scattered flakes in a gully or road cut. Once flakes are found, a search in the area will usually uncover the deposit. Some idea of the quality of the material can usually be determined on the spot by use of any type of hand torch. To be of potential commercial value, vermiculite must expand readily when heated.

To be of commercial importance a vermiculite deposit must have the following properties:

(1) It must expand to a high degree when heated and the flakes must be of the sizes required by the market. Large flakes can be crushed, but very small flakes are not in demand.

(2) The percentage of vermiculite to gangue material must be high, usually 40 per cent or more vermiculite.

(3) The deposit must be large, inasmuch as a large deposit is easily worked by power shovel, which is required for a low cost operation. Attempted operations of small and scattered occurrences of vermiculite have not been successful.

If an exposed deposit meets the above requirements, it is safe to develop it further by stripping or terracing with a bulldozer to determine its areal extent and by drilling or sinking shafts to determine its depth.

Occurrences of Vermiculite in Virginia

Geologic conditions in Virginia are favorable for the occurrence of vermiculite in parts of the Piedmont province, and at present there are five districts in which vermiculite is known to occur. These districts are outlined on Figure 1 and are as follows: (1) The Louisa County district, in the western part of Louisa County; (2) the Buckingham County district, embracing a small area in west-central Buckingham County several miles northwest of Buckingham Court House; (3) the Bedford-Franklin counties district extending from central Bedford County into northeastern Franklin County; (4) the Pittsylvania-Franklin counties district in northwestern Pittsylvania County and the southern half of Franklin County; (5) the Henry County district, in the southern half of Henry County; and (6) the Charlotte-Halifax counties district, in southwestern Charlotte County and western Halifax County.

Louisa County District: This district is in the western part of Louisa County and is referred to locally as "The Greensprings." It is underlain by basic rocks that have been intruded by a series of small pegmatites, and is traversed by U. S. Highways 15 and 33 and several

secondary roads. Vermiculite is exposed in road cuts on both of these highways and also along several of the secondary roads. The vermiculite in this district expands readily when heated with a hand torch, and appears to have commercial possibilities. Exposures in the road cuts indicate that fairly large tonnages are available; however, the flake size is small and would limit the uses to which the material could be applied.

Buckingham County District: The geology of this district, which is located in the west-central part of Buckingham County, is similar to that of the Louisa County district. The district is underlain by basic rocks that have been intruded by small pegmatites, and several deposits of vermiculite are exposed along road cuts. Preliminary tests show that the vermiculite expands readily, but the flake size is smaller than that from the Louisa County district. Thus the uses of the vermiculite from the Buckingham County district appear to be limited.

Bedford-Franklin Counties District: Vermiculite is known to occur in an area that extends from near Forest and Goode in north-eastern Bedford County, southwestward to the vicinity of Taylors Store in Franklin County. However, most of the known deposits in this district are concentrated in a narrow strip that runs northeast-southwest through Moneta, Bedford County. The area, for the most part, is underlain by hornblende gneiss and biotite gneiss, and numerous pegmatites are present. Vermiculite from several exposures in this area expands readily. Several of the exposures indicate that considerable tonnages may be available here.

Pittsylvania-Franklin Counties District: Scattered exposures of vermiculite occur in an area extending from the northwestern part of Pittsylvania County southwestward to the southwestern tip of Franklin County. This district is underlain by several rock types, but the vermiculite is found in hornblende and biotite gneiss and possibly also in pyroxenite. There are indications of a concentration of deposits in the Toshes-Museville district of northwestern Pittsylvania County. Vermiculite from some of the exposures examined expands very well, but most of the deposits appear to be limited in extent.

Henry County District: In this district the known deposits of vermiculite occur in the southwestern half of the county, with most of them concentrated around Ridgeway. The deposits occur in hornblende and biotite gneiss, which in some instances have been intruded by pegmatites.

The vermiculite in several of the deposits in this district occurs in good size flakes and shows very good expansion when heated with a torch.

There has been exploratory work in the form of bulldozing and some auger-drilling on

several deposits in this district, but as yet there has been no production. This district appears to offer possibilities for further exploration and possible commercial production.

Charlotte-Halifax Counties District: In this district vermiculite deposits are scattered from near Phenix in Charlotte County southwestward to the vicinity of Paces and Turbeville in Halifax County, with no apparent concentration at any one locality. Most of the deposits occur in a hornblende gneiss that has been intruded by small pegmatites. The vermiculite in this district occurs in very small flakes, for the most part and from indications, no very large tonnages are available here.

Future Possibilities

The writer has been making a study of vermiculite deposits in Virginia for the Virginia Division of Geology, for the past six months and, upon completion of the project, a more comprehensive report will be published by the Division. From results of the study to date, the most promising districts for possible commercial production appear to be (1) the Louisa County district; (2) the Henry County district, and (3) the Bedford County district. This belief is based on flake size, results of expansion tests with a hand torch, and possible tonnages available as indicated from known exposures.

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U. S. GEOLOGICAL SURVEY PROJECTS

Among projects in which field work is in progress by the U. S. Geological Survey in Virginia and adjoining states, which should be of interest to many are:

1. Southeastern Granites, J. B. Mertie in charge.

Primarily a study of the heavy mineral suites of the granites of the Southeastern States, with both the economic objective of outlining areas favorable for the recovery of monazite, and the scientific objective of developing criteria for distinguishing ortho- and para-genesis. Samples were collected in Virginia this summer.

2. Sedimentary Petrology of Selected Areas in Virginia, D. Carroll in charge.

An investigation concerning the mineralogy of rocks and soils and the mechanical composition of soils and unconsolidated deposits of the area in Augusta County drained by South River and its tributaries. This project was begun in 1952. Statistical studies of the heavy minerals in stream sands are in progress and one paper, "A Statistical Study of Heavy Minerals in the Sands of the South River, Augusta County, Virginia," is now being reviewed for publication. Samples of a bentonite bed in the Martinsburg shale in Rockingham County have been collected for examination of heavy mineral content.

3. Igneous Petrology of Shenandoah Valley and West Virginia, C. Milton in charge.

This project includes the petrographic study of igneous rocks of the Broadway, Harrisonburg, Waynesboro, Parnassus, Staunton, McDowell and Monterey (15-minute) quadrangles. Samples

will be collected but no geologic mapping is contemplated this year.

4. Quadrangle Mapping, C. Milton in charge.
Geologic mapping of the Fairfax and Manassas 15-minute quadrangles on 7.5-minute quadrangle sheets.

5. Potomac Basin Erosion Studies, J. T. Hack in charge.

Field studies of soils and other surficial deposits in Shenandoah Valley. Reconnaissance mapping is in progress in the vicinity of Harrisonburg, Staunton and Waynesboro. A Professional Paper report on erosion processes, and vegetation in mountain valleys of the Central Appalachians is nearing completion. A report on "Studies of Longitudinal Stream Profiles in Virginia and Maryland", has been approved for publication as a Professional Paper.

6. Petroleum Geology of Northeastern Lee County and Western Scott County, Va., L. D. Harris in charge.

Mapping of the Duffield (7.5-minute) quadrangle in Scott County has been completed and the results have been approved by the Director for publication in the Geologic Quadrangle Map series. Field work will be resumed this fall in the adjacent Sticklelyville quadrangle.

7. Geology and Mineral Resources of a Part of the Southern Appalachian Folded Belt, J. G. Stephens in charge.

Mapping of the Virginia and Tennessee parts of the Ewing and Varilla (7.5-minute) quadrangles has been started in collaboration with another U. S. Geological Survey party mapping the coal geology on the Kentucky side of the State boundary. The geologic mapping of the Ewing-Varilla area is part of a long-range plan, aimed at developing an integrated picture of the stratigraphy, tectonic history, and interrelationship between the Cumberland Plateau, the southern Appalachian folded belt of southwestern Virginia and northeastern Tennessee, and the Blue Ridge and Piedmont provinces of North Carolina. The work should contribute toward the evaluation of the oil and gas potential of the southern Appalachians and provide data on the geologic setting affecting the emplacement of the ore deposits found in all three of the provinces.