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NORTH CAROLINA
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
R. BRUCE ETHERIDGE, DIRECTOR

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THE GEOLOGY AND MINERAL RESOURCES
OF
GUILFORD COUNTY

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N. C. GEOLOGICAL SURVEY

By
Thomas G. Murdock

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DIVISION OF MINERAL RESOURCES

THE GEOLOGY AND MINERAL RESOURCES OF GUILFORD COUNTY

By: Thomas G. Murdock*

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Foreword

This summary has been prepared as one of a series to set forth the available information on the geology and mineral resources of the counties of North Carolina. Any investigation and appraisal of the mineral wealth of any area is one which must be based on incomplete information as economic trends and conditions are an ever-changing factor which determines the possibility of any commercial exploitation and even limits geological investigation to current necessities. Even a brief study of the literature on the subject, as applied to Guilford County, indicates the need for additional investigation, and a more complete appraisal of the possibilities. The present survey can thus only suggest a line for detailed investigations in

*Assistant State Geologist, Division of Mineral Resources.

the light of the discovered mineral deposits and the development of the mineral industry in the area. Any study which undertakes to suggest the establishment of industries utilizing mineral raw materials must of necessity consider an area larger than an individual county and likewise can only be suggestive of possibilities which warrant further investigation.

On such a basis, Guilford County, on account of its geological constitution, does not contain any mineral resources which under present or immediate future conditions could be the basis for the establishment of new industries of any importance. There could undoubtedly be an expansion in the development of local resources for already established uses. Likewise there exist several possibilities which deserve a thorough investigation--possible opportunities for the establishment of new industries utilizing mineral raw materials from nearby areas, to complement other industries, or to contribute to the local economy by utilizing materials from nearer sources, such a development being possible because of very favorable manufacturing conditions and the existence of local markets. None of these can be accepted as definitely suggested projects; they are, however, ones which deserve complete investigation and appraisal.

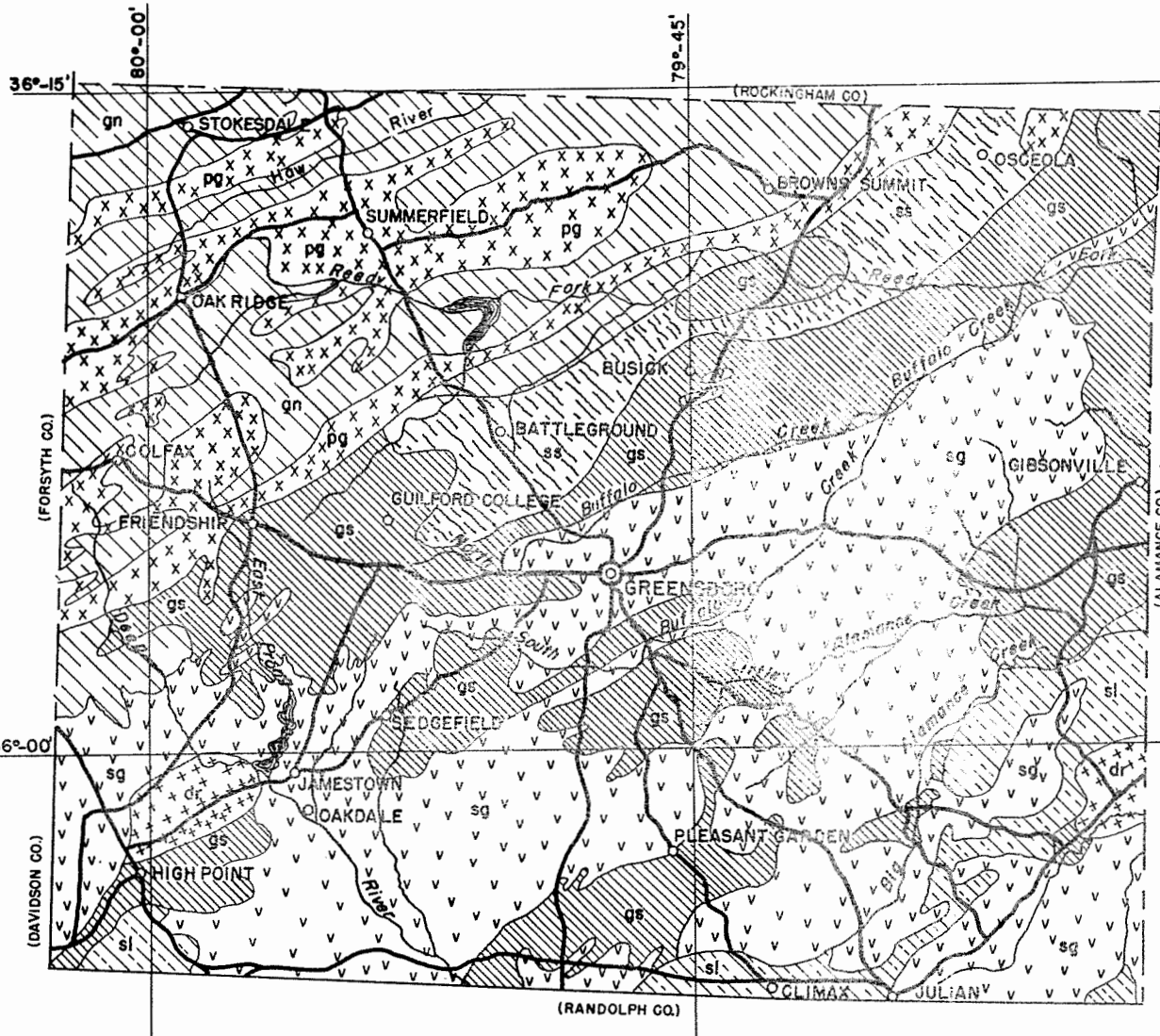
Areal Geology

Most small scale maps of North Carolina show the greater part of Guilford County to be underlain by Carboniferous granite, the extreme southern portion by the slates of the Carolina Slate Belt, commonly regarded as of Algonkian age, and the northwest corner by mylonitized granite gneiss, also of pre-Cambrian age.


This generalization is essentially correct although locally the large area of Carboniferous granite may be subdivided into several lithological units to such an extent that it might better be described as an area of ancient metamorphic gneisses and schists widely injected by intrusions of Carboniferous granite.


Alternating belts of granite and gneiss occupy most of the northwest half of the county. The most extensive area of granite extends from High Point northeastward, and several areas occur in the southeast corner of the county. The granites are of two general types: one a sheared variety carrying biotite as the chief characterizing accessory and a more massive one which at many places exhibits a porphyritic texture. Examination of the granite outcrops in the county indicates that many of them have a schistose structure, with some additional evidence of crushing and mashing from pressure metamorphism.


Basic intrusive rocks are somewhat numerous over all parts of Guilford County. The principal types include diabase and diorite and their altered products, greenstone and amphibolite. Both massive and schistose structures are represented in the rocks and on this basis not all of the rocks belong to the same period of intrusion, but several periods are represented.





EXPLANATION


- 


PORPHYRITIC GRANITE: Chiefly coarse gray porphyritic granite, at some places equigranular. Usually massive, occasionally gneissic.
- 

DIORITE: Usually fine to medium grained, gray to dark greenish gray; chiefly plagioclase and hornblende. Massive in many places, but schistose or gneissic at a few.
- 

SHEARED GRANITE: Light pink to gray, mostly coarse grained biotite granite. Greatly sheared, at places schistose or gneissic.
- 

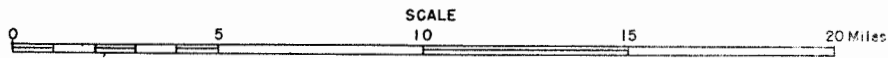
SLATE: Chiefly gneissic, schistose or slaty tuffs consisting of mineral grains and fragments in a fine-grained matrix of volcanic ash and some land waste. Includes some clay slates.
- 

SERICITE SCHIST: Chiefly sericite, quartz-sericite and chlorite-sericite. Usually fine grained and finely foliated.
- 

GREENSTONE SCHIST: Green schistose mafic rocks chiefly of volcanic origin, including lava flows, tuffs, breccias and intrusives.
- 

GNEISS: Chiefly quartz-mica-feldspar gneiss and quartz-mica-schist. Mostly of sedimentary origin.

GEOLOGIC MAP OF GUILFORD COUNTY, N.C.



Prepared by M.J. Mundorff as a part of a cooperative program of ground water investigation by the U.S. Department of the Interior, Geological Survey, and N.C. Department of Conservation and Development, Division of Mineral Resources.

Within the county there are a number of diorite bodies; the largest occupy areas of several square miles. The rock is best exposed at the old County quarry within the northeast limits of the City of Greensboro.

That area of Guilford County covered by the rocks of the Carolina Slate formation is part of a wide belt which crosses the State in a northeast-southwest direction. These rocks comprise a great series of schistose volcanics and slates; the series is composed of ash and tuff of rhyolitic and andesitic composition, flows of rhyolite and andesite, and beds of shale, all of which have been metamorphosed into schistose and slate-like rocks. The slates outcrop in a very irregular belt near the southeast corner of the county.

Throughout the central and southeastern portions of the county there are numerous elongated masses of greenstone schist which were formed by the metamorphism of intrusive and extrusive basic rocks.

Economic Geology

Metallic minerals

Gold--During the early days of gold mining in North Carolina, several properties in Guilford County were active and some of them have a record of an appreciable production over a period of time. The mines about which some authentic data are available may be described briefly as follows:

The Gardner Hill^{1/} mine, eight miles southwest of Greensboro, is on two or more well-defined veins in granite. It was extensively developed long before 1861, but it is understood to have been idle most of the time for the last eighty years. At times since 1880 parts of the dump were milled, and in the summer of 1934 the workings were unwatered. In 1854 Ebenezer Emmons, then State Geologist of North Carolina, estimated that the mine had produced \$100,000 from the "lode and surface" (placer) workings. A shoot of "brown ore" six to twelve inches wide yielded \$20 a ton. At a depth of 110 feet on a 40° slope the lode contained iron and copper pyrites. At a depth of 258 feet ore containing 25 per cent of copper and from \$3 to \$10 a ton in gold is said to have been mined. The total extent of the lateral workings is given as 5,000 feet. The workings that were unwatered and made accessible in September 1934 include three shafts of which the deepest reached a point 208 feet vertically below the surface and 3,000 feet of connected levels and crosscuts. They expose a vein that varies somewhat in strike but averages about N 20° E and dips 20° - 35° NW. At the 150-foot level a branch splits off and continues downward at a steeper angle. Parts of the veins, presumably representing ore bodies, have been stoped out. One of these is from 60 to 120 feet long and 270 feet or more high (pitch length). Remaining parts of the vein range from one to five feet or more in width. These consist of quartz with variable amounts of pyrite and chalcopyrite. Next to the hanging wall the vein is brecciated, and the wall itself is slickensided and bordered with a layer of schistose material, the structure of which indicates that the wall has been thrust upward. Large bodies of the vein rock remaining in place are sufficiently exposed for sampling.

^{1/} References are at end of paper.

The North State and Lindsey mines^{1/}, about four miles southwest of the Gardner Hill, are on a vein or group of veins a mile long that strike northeast in granite. These mines were active before the War between the States. A yield of nearly \$35,000 in gold and more than \$10,500 in copper from the North State is reported between March and November 1854, and the total production is estimated to be at least \$125,000. The underground workings are described as extending for a distance of several thousand feet, the deepest shaft being 350 feet deep. Except for intermittent operations, chiefly in the 1880's, the mines have been idle for the last 85 years, and the workings were not accessible in 1934. The vein is said to dip southeast at varying angles. To a depth of fifty feet it was very productive in gold, and between fifty and one hundred feet it yielded much copper. The ore occurs in shoots and pockets and consists of pyrite and chalcopyrite in a gangue of quartz and siderite. Native gold occurs in both the oxide and the sulphide zones. A selvage of schistose material lies on the walls.

The Fentress mine^{1/}, about ten miles south of Greensboro, is another old mine on a northeast vein in granite. It was opened before 1853 as a gold mine. Below fifty feet iron and copper sulphides are found, and the deposit has the distinction of being the first in North Carolina to be mined for copper. Except for intermittent operation during the period 1901-1907, the mine has been idle most of the time since 1865. In 1856, Emmons reported a production of \$133,000. The period 1901-1907 yielded nearly \$26,000, and the total to date is estimated at \$175,000. The same author mentions a sulphide ore body developed on the 310-foot level, eighty to ninety feet long and 34 inches in greatest thickness, that yielded ore carrying 14 to 23 per cent of copper. The vein is reported by other observers to range from one foot to eight feet or more in width and to be composed of quartz and iron carbonate with pyrite and chalcopyrite. Emmons comments that "a discouraging feature is long intervals of barren vein between ore shoots." According to Pratt who examined the mine in 1906, the vein is a composite of stringers, copper was scarce in the lowest levels, and the gold is associated with pyrite.

The Hodges Hill mine^{2/}, about six miles southeast of Greensboro, lies near the eastern border of the granite belt. The vein ranges in width from six inches to twelve feet and has been opened up by pits along the outcrop for a distance of 800 or 900 feet. The vein is essentially quartz lying rather flat and contains other gangue minerals, as pyrite, siderite, chalcopyrite, and limonite. The chalcopyrite at times has been altered to malachite and red oxide.

The Fisher Hill and Millis Hill mines^{2/} are approximately six miles slightly west of south of Greensboro. It is reported that 15 veins are found on the property. There are two systems of veins, one which runs approximately north and south, and the second nearly northeast and southwest. The dip of the vein varies from 15° to 20°. The veins are composed of quartz carrying heavy percentages of pyrite with little copper. The veins have been traced for a distance not less than eight miles, though not capable of being worked the entire distance. However, the vein has been successfully operated at several points in the eight miles distance. The ore body is said to range from four inches to ten feet in thickness and at times carried relatively high values.

The Twin mine^{2/} is six miles southwest of Greensboro. The veins strike N 40° E and dip southeastwardly. They are about 18 inches in thickness with four feet of slate between. They are composed of quartz and carry small amounts of chalcopyrite.

Economic importance--The fact that the gold mines of the county have been idle for such a long time, even when there was considerable activity in adjacent regions, suggests that the individual properties, at least on the basis of past experience, were marginal ones. However, the occurrence of associated sulphides indicates a complex ore which, while difficult to treat during the earlier periods of operation, would today offer no serious metallurgical difficulties. This association of copper and possibly lead and zinc would increase the unit value of the ore, and it is possible that future demands for those metals might increase the possibility of an economic development.

It is doubtful if much gold remains in the upper zone at these properties. It is possible that there might be some ore remaining in an intermediate zone, and at depth there may be important ore bodies. The ore in the lower zones, however, would be expected to contain the gold locked up in sulphide minerals and recoverable economically only after flotation.

It appears that the gold deposits of Guilford County constitute a resource of an unknown value. It is doubtful if any important mining industry will ever be developed. Extensive exploration followed by comprehensive sampling and treatment tests will be necessary to determine whether any particular body is workable or not. The development of the better properties depends entirely upon the availability of "venture" money and investment on any other basis should be discouraged.

Iron^{3/}--A belt of titaniferous magnetite extends across Guilford County in a northeasterly direction and passes beyond the boundaries of the county into Rockingham on the northeast and Davidson on the southwest. It lies to the north and west of Greensboro. It consists of two parallel subordinate belts known, respectively, as the Tuscarora belt and the Shaw belt, the total length of which is thirty miles. The longer and more persistent is the Tuscarora belt. The Shaw belt lies several miles northwest of it.

The area is one of prevailing granites and gneisses within which are smaller bodies of gabbro. Though evidence of the presence of the gabbro is obtained repeatedly along the belt by outcrops and surface fragments, it seems that the belt is not one elongated mass of gabbro but consists of a number of smaller masses having a linear distribution along the belt. The ore bodies are segregations within these small gabbro masses and do not constitute a continuous body extending the entire length of the belt.

Surface outcrops of the ore bodies are lacking and, as the old workings have all caved, the character of the ore can be judged only from the surface fragments. A detailed examination of the belt was made in 1871, and it was learned that the ore bodies consist of strings of lens-shaped masses continually enlarging and contracting in thickness from a few inches to six or eight feet. The principal beds were estimated to average four feet and in the best mining localities the average thickness found in a long drift was estimated at five feet.

The Tuscarora mine was worked in the 70's by a Philadelphia mining company. Forges were erected on a small stream one-half mile northeast of the principal shaft, and considerable iron is said to have been made. It seems that the titaniferous ores could readily be smelted in the old Catalan forges and yielded a superior grade of iron. The Tuscarora mine consisted of several shafts extending about a mile along the ore belt. The principal shaft, the Sargeant, was situated one and one-half miles north of Friendship. It reached a depth of 109 feet and a tunnel run in from this depth is said to have cut a bed 12 feet wide. Outcrops of granitic gneisses occur in the vicinity of the mine, but the immediate country rock is gabbro. It is an olivine gabbro with diabasic texture. No ore in place is now exposed, but judging from the fragments lying about on the surface it is a medium to coarse-grained ore of good grade. The following tabulation of analyses gives the composition of the ore:

Analyses of Ore from the Sargeant Shaft, Tuscarora Mine^{4/}

| | | | |
|---------------|-------|-------|-------|
| Silica | 1.31 | | 12.86 |
| Metallic iron | 55.06 | 53.20 | 53.27 |
| Alumina | 4.26 | | |
| Sulphur | Trace | Trace | Trace |
| Phosphorous | Trace | 0.005 | Trace |
| Titanic acid | 13.60 | | 13.58 |
| Chromic oxide | 0.72 | | |

About two miles northeast of the Tuscarora mine, on the south side of Brushy Creek, some work revealed a similar ore, slightly less coarse, in association with gabbro.

Some work was done on the Shaw belt, three miles west of Summerfield, but the only extensive workings were those on the north side of the Haw River close to the line between Guilford and Rockingham Counties. Ore was worked from pits in Revolutionary times, and a Philadelphia concern operated the Dannemore mine on this property prior to 1886. The records give the dimensions of ore of the lenses as 125 feet long, 80 feet in incline width, and 12 feet thick. The ore was said to be somewhat leaner than the Tuscarora mine ore but with a similar granular aggregate of ilmenite and magnetite, but without a pronounced intergrowth of ilmenite in the magnetite grains.

Economic importance--The titanium content of the Guilford County ores is about normal for titaniferous magnetites. Of the large number of available analyses, the average TiO_2 content is about 13 per cent. The ilmenite and magnetite occur as granular aggregates in the ores in such a manner that most of the titanium can be eliminated with little loss of magnetite. The resulting concentrate runs high in iron and is low enough in titanium to make possible the utilization of these ores in normal blast furnace practice by mixing them with titanium free ores. On the other hand, little is known in regard to their geologic occurrence and size on account of lack of exposures. Such conclusions as can be drawn from old data and the nature of the deposits are not very favorable to them. The ore bodies seem to be rather small and irregular in distribution, so that mining operations would be attended by considerable uncertainty. On the whole, therefore, the belt is not very promising as a source of iron ore. ^{7/}

The North Carolina Steel & Iron Works erected a blast furnace of 100-tons capacity at Greensboro in 1892, but even this operation utilized ore from other parts of the State to a large extent. This furnace found it difficult to compete with the development of the industry in Pennsylvania and Alabama and operations ceased around 1900. The opening of the great ore deposits of the Lake Superior region marked the end of this industry in the State.

During the present century, there has been little activity in iron mining in North Carolina. During World War I, a small tonnage was shipped from western counties to Tennessee and Alabama furnaces.

During World War II, considerable thought was given to the possible utilization of the larger deposits of the State for the production of sponge iron to relieve a pressing scrap shortage. Detailed field investigations were made of deposits in Lincoln, Avery, and Cherokee Counties by H. A. Brassert and Company, a well-known firm of consulting engineers. This was followed by exploration work conducted by the U. S. Bureau of Mines. The Guilford County ores were considered as of a secondary importance; it was, however, recommended that a magnetic survey of the area be made to obtain additional information as to the possibilities of the occurrence of deposits of commercial size; some preliminary work was done, but the results were not encouraging.

During the spring of 1944, reduction tests for producing sponge iron from North Carolina ore were carried on by the U. S. Bureau of Mines at the plant of the Isenhour Brick and Tile Company at Salisbury. These tests have more than come up to expectations and some excellent sponge iron has been made.^{2/}

It would appear that the only possible iron development in Guilford County might be the location of a sponge iron plant there. This process, the oldest known, has now become highly developed and still remains the cheapest one for the production of purest metal. There are several individual processes for the manufacture of sponge iron but the one which has been considered most important for local application is a low temperature process using hydrogen gas in place of solid fuel. The hydrogen could be derived from coke produced from Deep River Coal.^{6/}

Unfavorable situation of the county with respect to the larger deposits of iron ore in the State would suggest the location of a sponge iron plant in Greensboro as economically impracticable. It is true that in the nearby north-central counties of Chatham, Orange, Randolph, and Durham there are iron deposits, but these are very irregular in grades, too small for commercial development, and the veins are too narrow for economical mining. The Guilford and Rockingham ores are likewise, on the basis of available information, as yet unproven commercially exploitable. The deposits of Avery, Ashe, Lincoln, Gaston, and Cherokee Counties, all some distance from Guilford, would logically be expected to be the first ones developed. On the other hand, Guilford County is particularly favored in a close proximity to the Deep River Coal Field of Moore, Lee, and Chatham Counties. The county is also favorably located with

respect to local markets for iron and steel-end products of electric furnaces and forging equipment operated in conjunction with a sponge iron reduction plant. The titanium content of the Guilford ores might be recoverable as a by-product, as will be explained later; in this event and provided ample reserves are found, the local ores might prove more attractive.

Estimates^{6/} made in 1943 indicated that the cost of a sponge iron plant of 100-tons daily capacity, which is about the largest to fit North Carolina conditions, would cost approximately \$850,000. If electric furnaces and a forging or extrusion press are added, this figure would exceed \$1,250,000. Smaller plants would cost relatively more; for instance, one of 25-tons daily capacity would cost about \$400,000. To warrant the installation of a 100-ton plant for normal operation about 3,000,000 tons of ore must be expected, of which 1,000,000 tons should be definitely determined as of a suitable grade and quantity, proven by drilling, test-pitting or underground development. It is not necessary that this tonnage be found in one deposit, but it should be within economical haulage distance of the plant.

Before any definite final conclusion can be drawn as to the future possibility of the economic importance of the Guilford ores, it is necessary that exploration work be carried out to determine the size and average analysis of the ore bodies. This will involve geological and magnetic surveys, followed by test-pitting, trenching and diamond or churn drilling. Such an exploration should be considered as a part of a long-range plan for the eventual development of the natural resources of the county, but recognizing that the records to date indicate that the belt is not very promising as a source of iron. Should sufficient ore reserves be established, it is possible that the other requirements for a sponge iron plant location could be met.

Titanium--In the early days of iron mining in North Carolina, the titanium content of the magnetites was considered an objectionable feature. More recent developments have indicated that the high titanium of the Guilford County ores might be an advantage, not for steel making, but for recovering titanium, in the form of the oxide ilmenite, as a by-product.

The utilization of ilmenite in the manufacture of titanium pigments is now an established industry and in 1944 the United States' consumption for this purpose amounted to almost 350,000 short tons. Previous to World War II the major source of ilmenite had been Travancore, India, however the unavailability of this supply led to the development of a domestic industry. The success of this industry is reflected in the increase of domestic production from 20,668 short tons in 1940 to 278,610 tons in 1944. This development has even been felt in North Carolina, where the Yadkin Valley Ilmenite Company has started exploitation at an ilmenite property near Lenoir and in 1944 produced about 15,000 short tons of concentrates averaging 49 per cent titania (TiO_2). A high ilmenite content of the sands of Albemarle Sound has also led to the leasing of the area to one of the large pigment producers for exploration and possible development.

The most spectacular development in the country has been that of the National Lead Company, at Tahawus, New York. This company has constructed a mill for processing a magnetite ore containing 16 per cent TiO_2 and 33

per cent Fe, and in 1944 milled about 1,000,000 tons of ore; the ilmenite concentrates averaged 44 per cent TiO₂ and the magnetite 56 per cent Fe. Ore reserves at the property are estimated at 43 million tons.

From work that has been done, it is indicated that the recovery of ilmenite from at least some of the Guilford County magnetites is technically possible.^{7/} A study of polished sections of the ore from the Tuscarora mine shows that gangue minerals constitute only a small part of the surface. Ilmenite grains make up one-fifth to two-fifths of the surface and the ilmenite intergrowths in the magnetite are so coarse that they are easily discernible with the naked eye. Some experimental work has indicated a magnetic separation as satisfactory, and the literature shows the following result:

Results of Magnetic Separation of Tuscarora Ore

| | <u>Unscreened Ore</u> | <u>Ore Through 50-mesh Over 100-mesh(a)</u> | | <u>Ore Through Screen Finer than 100-mesh(b)</u> |
|------------------|---------------------------|---|---------------------------------|--|
| | | <u>Magnetic Per cent</u> | <u>Nonmagnetic Per cent</u> | <u>Magnetic Per cent</u> |
| Quantity | | 71.5 | 28.5 | 70.1 |
| Fe | 58.07 | 67.76 | 33.76 | 68.41 |
| TiO ₂ | 12.82 | 4.25 | 34.32 | 3.64 |

- (a) 44.6 per cent
- (b) 55.4 per cent

These results show that little is to be gained by grinding finer than 50-mesh; that is, notwithstanding the coarseness of the ilmenite intergrowths, they are still too fine to be separated by grinding to 100-mesh. If all the TiO₂ in the tailings is assigned to the ilmenite, they contain about 75 per cent ilmenite with a residue of 6.38 per cent Fe. Some of this iron occurs in the gangue minerals present, so that very little magnetite adheres to the ilmenite or gangue.

Economic importance--The tests above described were undertaken with a view to the possible beneficiation of the magnetite rather than the production of an ilmenite concentrate as well. It seems logical to believe that with the advances made in magnetic separation, since the original tests, a selective concentration to produce both commercial ilmenite and magnetite will be possible. The determination of the magnetite ore reserves of the belt would permit of detailed studies of the economics of ilmenite recovery and estimation of titanium reserves. The apparent smallness of the ore bodies is a disadvantage, but further exploration might develop a large aggregate reserve for the belt as a whole. Further exploration is necessary before undertaking any concentration tests or even being sure that the preliminary tests were on a representative ore. Nevertheless, the possible recovery of ilmenite should be considered as a future possibility and eventually measures be taken to determine the economics with more factual data.

Non-metallic minerals

Granite^{8/}--The local mineral resource of Guilford County which has the widest distribution and which has had the greatest development is granite.

The granites of the county are best treated separately under individual areas.

Brown Summit Area--One and one-half miles southeast of Brown Summit station, ten and one-half miles northeast of Greensboro, are flat surface exposures of a light gray schistose granite extending over several acres of surface. Some of the granite was reported to have been first quarried prior to the Civil War. It was more extensively worked later for stone to be used on the streets and in some of the buildings in Greensboro, and to some extent in bridge construction. The rock is a biotite granite, schistose in structure, and contains much muscovite in places. It is quite variable in texture and color and is penetrated by very many veins and dikes of pegmatite, composed largely of feldspar and quartz with a sprinkling of biotite. On account of the shearing and schistose structure and the rather numerous veins, the use of granite is limited to the lower grades of work.

Friendship Area--Friendship is ten miles west of Greensboro and on the Wilkesboro-Winston Salem Division of the Southern Railway. Two miles northeast of Friendship several openings have been made in granite and some production from this area has been reported. The records indicate only surface working. The rock is a porphyritic biotite granite of variable texture and color and of rather inferior quality. The amount of biotite is rather large in places and a dark gray color prevails. Outcrops of granite are found between Friendship and Oak Ridge, and in the vicinity of the latter, five miles northwest of Friendship, and within a few miles of the Forsyth County line.

Jamestown Area--One-half mile southeast of Jamestown, on Bull Run, several openings have been made in granite. The rock is a fine-grained, dark gray, thinly schistose granite-porphry, composed of bluish opalescent quartz, white opaque feldspar, and biotite. It can not be used for general building purposes because of the close jointing not admitting of dimension stone being quarried; otherwise, it is an excellent rock possessing great hardness and toughness.

A large granite area is found around Oakdale cotton mills, one mile southeast of Jamestown. The rock is of medium texture, somewhat resembling that exposed on Bull Run except that it is coarser in texture and more schistose in structure.

About four miles east of High Point rather extensive operations have produced a large amount of stone. The rock is a fine to medium-grained gneissic biotite granite of medium to dark gray color and fairly uniform in both color and texture. It is a desirable granite for many purposes.

Greensboro Area--The City granite quarry, situated about one and one-fourth miles north of the courthouse has been a large producer. The rock is a medium coarse-grained biotite granite, massive in structure and of medium gray color. It is quite uniform in both color and texture, and it is of pleasing appearance but dimension stone can not be quarried because of close jointing.

Diorite has been quarried at the County quarry in the northeast part of the city. The rock has been much crushed from pressure metamorphism and both it and intruded diabase are closely jointed.

About five and one-half miles northeast of Greensboro are exposures of a partially decayed fine-textured, light gray biotite granite displaying pronounced effects of pressure metamorphism and close jointing. For this reason, the rock is entirely unsuited for any purpose except as crushed stone.

Summerfield Area--Summerfield is a station on the Sanford-Mt. Airy branch of the Southern Railway and is 12 miles northwest of Greensboro. Six miles northwest of Greensboro on the Battleground road a medium fine-textured biotite granite outcrops on both sides of the road. The granite is nearly continuous northwestward from this point to and beyond Summerfield. It is porphyritic in places, but the rock over the greater portion of the area is an even-granular granite, the two textures representing different phases of the same granite mass. The main developments in this area have been about one-fourth mile south and one mile southwest of Summerfield.

Stokesdale Area^{2/}--The Guilquarry operation, one of the largest in the county, is near Stokesdale about 18 miles northwest of Greensboro. It was formerly operated by Guilford County but was bought by the Raleigh Granite Company in 1932 and has later been leased to other operators. In 1940 it covered approximately seven acres, the main walls were ninety feet high, and a sublevel with 30-foot walls was being developed. Drilling was by wagon drills carrying a 30-foot face, and the stone was loaded by hand into 2-cubic-yard pit cars, which were pushed by hand to the foot of an incline, up which they were hauled by a hoisting engine and dumped into a 13-inch jaw crusher. The discharge from this crusher passed over a scalping screen into a 4-foot cone crusher, the discharge of which was carried by bucket elevators to the sizing screen on top of the storage bin. The plant is on the Atlantic & Yadkin R. R., but about ninety per cent of its output has been hauled away by truck. In 1938 this plant produced 98,000 tons of stone.

Quarry operations--A survey of the operations of the State Highway and Public Works Commission, made in October 1941, listed the following granite quarries in Guilford County:

| <u>Name</u> | <u>Location</u> |
|---------------|----------------------------------|
| Buck Mountain | 2½ miles west of Climax. |
| Busick | 6 miles north of Gibsonville. |
| Kiveh | 3½ miles east of High Point. |
| Pearman | 3 miles southwest of Stokesdale. |
| Rock Creek | 8½ miles east of Greensboro. |

The 1945 canvas of the U. S. Bureau of Mines indicates that Piedmont Quarries Company and the Buchanan Stone Company were the only producers of commercial granite in the county during that year.

Economic importance--The nature of the granites of Guilford County is such that they are, in general, not suited for the production of dimension

stone. Thus their utility is as crushed stone, for which purpose the granite is quite suitable. It is believed that the distribution of granite throughout the county is such that requirements for local use can be obtained so near the construction site that haulage will be a minimum expense. The popularity of the established granites from nearby Rowan and Surry Counties is such that even if granite suitable for dimension stone be located it could hardly compete with these. The availability of rocks suitable for crushed stone use throughout the entire Piedmont area and limit of economic haul from Guilford quarries means that production will be limited, in general, to local needs. However, any extensive building program and the improvement of secondary highways should lead to a greater consumption. It is believed that several modern quarries, with completely mechanized equipment, could eventually find a market for their product. High labor costs have necessitated mechanization and thus a few large quarries are to be expected rather than numerous smaller ones. Any production of certain types of pre-fabricated housing might be expected to use a considerable amount of local aggregates, and the experience of the Arnold Stone Company of Greensboro indicates that pre-cast concrete products can be successfully marketed from Greensboro.

The possibility of finding a use for granite fines or screenings is one which deserves study; this will be discussed in some detail elsewhere. The Mt. Airy operations market some of their fines as a poultry grit, but it is doubtful if the Greensboro granite would be as suitable.

Some detailed geological studies are needed to learn more about the granites of Guilford County. The available information was published in 1906 and needs revision in the light of more extensive exposures today available. Such work would be especially useful in determining location of future quarries and possible uses of granite fines.

Any discussion of the future of granite must consider the possibility of the recovery of feldspar, one of the main constituents of granite. A depletion of the reserves of this important mineral in western North Carolina has led to the utilization of a coarse-grained granite known as alaskite, the feldspar being recovered by flotation. One plant for this purpose is now in operation at Kona, Mitchell County. There are large reserves of alaskite in western North Carolina, and it is unlikely that there will be any early utilization of the finer-grained granites in the Piedmont for this purpose. When such a development does come, it is probable that the Rowan and Surry County granites would first be used for this purpose. The high content of biotite in the Guilford County ones makes them undesirable. Nevertheless, there may be local areas in Guilford where the feldspar has been weathered loose from the granite and large tonnages of material could be processed cheaply. This possibility should be considered in the suggested study of the granites of the county.

Clays--Guilford County has been an important producer of structural clay products for many years. The literature¹⁰ states that during the early part of this century both residual and sedimentary clays were found in abundance around Greensboro and that both were utilized by the brick manufacturers. The Greensboro Brick and Tile Company utilized a reddish residual clay resulting from the decomposition of gneissic rock. A similar

material was processed in the Dean and Watson brickyard. Kirkpatrick's brickyard was situated along North Buffalo Creek, and the clay processed was a portion of a deposit found more or less continuously along the creek southwestward to Pomona. During 1911-12 there were eleven producers in the county, and production was reported from Colfax, Kernersville, Greensboro, Pomona, and High Point.

The growing demand for a high-grade product led to the development of the shale brick industry of North Carolina and today the major part of the production of brick is from: (1) the pre-Cambrian slates of Davidson, Stanley, Anson, and Union Counties; (2) the Cambrian shales of Henderson County; (3) the Triassic shales of the Dan River Coal Field in Stokes and Rockingham Counties; or, (4) the Triassic shales of the Deep River Coal Field in Durham, Chatham, Lee, Moore, and Anson Counties.

Today the only Guilford County producer of structural clay products is the Pomona Terra Cotta Company, at Pomona. This establishment, in addition to ordinary structural clay products, manufactures a variety of specialties such as salt-glazed sewer pipe, flue lining, drain tile, and hollow tile. The raw materials for these has been Triassic shale which has been brought in from Rockingham County and more lately from the Deep River Coal Field. The company has also used a white, very sandy, coarse-grained fire-clay, found on the south side of North Buffalo Creek, for the manufacture of fire-brick. They have also utilized a pipe clay occurring to the north of the creek in the manufacture of sewer-pipe.

Another interesting development at Pomona is the operations of the North State Pyrophyllite Company. In these, pyrophyllite, a hydrous aluminum silicate, is brought from Snow Camp, Alamance County, and used in the manufacture of refractory bricks and cements.

Economic importance--A publication^{11/} issued in 1930 stated "no deposits of clay or shale giving promise of commercial development appear to be available." This is believed to be essentially true today, although the area within the Slate Belt should be examined for a shale which might prove suitable for brick making. Some samples from a point four miles south of Whitsett are interesting in this respect. It is believed that any future expansion in the present brick production of Guilford County will have to follow the example of the Pomona Company and utilize shales from the nearby Dan River or Deep River areas, or from the Carolina Slate Belt. A plant in Thomasville manufactures brick from the shales of the Slate Belt; several other plants in other counties process the same material. It is undoubtedly true that at the present time the county alone could absorb the production of several plants the size of the one at Pomona; however, once a building program stabilizes, it will be necessary to consider the competition from cement blocks and other construction materials and the needs of the area which can economically be served from Guilford County. The usual practice has been for the shale brick plants to locate adjacent to the shale deposits, and it is believed that this will be true in the future.

The production of refractories at Pomona may be considered as the mere beginning of a large industry. The consumption of pyrophyllite refractories will undoubtedly increase. Any greater industrialization in the State and even in adjacent states should lead to a much wider use of refractories of

all kinds. The wider use of forsterite refractories might permit of their manufacture in Greensboro; there is at this time some production of olivine from Jackson County which is shipped to Pittsburgh for manufacture. The huge reserves^{12/} of olivine, a ferrous magnesium silicate, of western North Carolina will permit of an extensive development.

A more recent discovery of sillimanite, one of the group of aluminum silicates which has found an increasing utilization as a refractory material, indicates a possible commercial occurrence. This mineral is found widely distributed in a zone which extends from Rutherford to Yadkin Counties, and there are additional occurrences in Clay, Buncombe, and Cleveland Counties.^{13/}

Any long range planning of industrial developments in Guilford County should not overlook the possibility of an increased and diversified refractory manufacture.

Emery--The literature contains some reference^{3/} to an occurrence of emery in Guilford County. The early exploration of the iron belt found one or two localities where the magnetite contains alumina in the form of granular corundum in such quantities as to constitute true emery ore. References as to locality are rather indefinite; one report^{4/} places the occurrence as seven miles northeast of Friendship on the old McCarvisten (or McCuistian) place; a later one^{7/} mentions the old Apple plantation just over the line in Rockingham County, southeast of Haw River. In the case of the latter report, no emery ore was found in place and no conclusions could be drawn as to the occurrence and size of the deposit.

Economic importance--If any quantity of emery could be located, it is quite possible that a local market could be developed for the manufacture of abrasive cloths and papers. In this connection it appears that Greensboro might be an excellent locality for the manufacture of such commodities utilizing other North Carolina abrasive materials. A local market exists in the various furniture manufacturing plants of the area. Raw materials exist in the State exclusive of the emery possibilities of the county; deposits of garnet of a possible economic exploitation are known in Jackson and Clay Counties, and ground quartz is produced as a by-product of feldspar, kaolin, and sand and gravel processing in the State. A study of the possibilities of synthetic abrasive manufacture, as well as utilization of natural abrasives found locally, should also be considered in any program of industrial expansion or economic development.

Fuels

Although no deposits of coal or oil would be expected in Guilford County because of its geological composition, the existence of the nearby Deep River Coal Field and the planned development there is of tremendous economic importance to the area. This coal field is situated in parts of Chatham, Lee, and Moore Counties and lies along Deep River fifty miles southeast of Greensboro and ten miles northwest of Sanford. It has been known for over 150 years and numerous efforts have been made to develop it without success. These repeated failures have not been due to the quality of the coal but to

other reasons. The coal in the field is of a bituminous character and has a heating value of approximately 14,000 b.t.u. It is a coking coal and tests have indicated the resulting coke to be fully equal in all respects to the best Pennsylvania ones. Early estimates^{14/} place the reserve at 68 million tons of recoverable coal that can be mined by modern methods. Exploration work recently executed and now planned by the U. S. Bureau of Mines and that done by private interests are expected to increase the original reserve. Plans have been announced by W. R. Bledsoe & Company, of Terre Haute, Indiana, an experienced coal mining organization, for an early commencement of development and production.

Coal also occurs in the Dan River Coal Field of Stokes and Rockingham Counties, however, extensive investigation indicates little likelihood of a commercial development.

The coal consumption of Greensboro and High Point alone have been estimated at 380,000 tons annually. The availability of a local supply, the freight rate upon which has been estimated at \$1.24 per ton to Greensboro, should effect an appreciable saving to all users.

This possibility is only one advantage. A comprehensive report^{6/}, prepared in 1943, recommended the construction of a by-product coke plant at Greensboro. The plant would produce, besides coke and gas, a quantity of medium temperature tars, ammonium sulphate--a fertilizer much needed by local farmers, and benzol and toluol could even be recovered. These by-products would, in turn, permit of the establishment of an extensive series of new industries. The tar and tar acids find a ready utilization as a road material; they could also be used for roofing manufacture, as a wood preservative, and as the basic raw material for phenol-formaldehyde (bakelite) type of synthetic resins and plastics. A hard pitch could be produced and this, in turn, coked to produce electrode carbon and additional light oils. In short, the possible ramifications are limited only by the initiative of industry in establishing secondary plants and developing local markets for the products.

The recent utilization of the Government's wartime oil pipe lines for the transmission of natural gas to strike-bound industrial areas has suggested a similar utilization of the line terminating in Greensboro. Such a measure would solve any local fuel problems and insure an industrial development for the area along lines never before dreamed of. Additional ceramic plants, for the manufacture of white and sanitary ware, and even a cement plant might prove possible. This development should in no way effect the benefits of the establishment of a by-product coke plant in Greensboro.

Ground water^{15/}

Ground water is one of the most valuable natural resources in North Carolina. Approximately seventy per cent of the total population of the State depends upon ground water for their water supply. Guilford County, in common with other counties of the Piedmont section, has fairly favorable conditions for ground water development, and a greater one may be expected. It is important that the relation of geology to ground water be considered in such a development.

A systematic investigation of the geology and ground water supplies in Alamance, Guilford, Forsyth, Caswell, Rockingham, and Stokes Counties has recently been completed as a unit and as part of a program of the State Department of Conservation and Development, in cooperation with the U. S. Geological Survey, started in 1941. A detailed survey of this unit involved the records of about 1,300 wells including many supplying municipalities and industrial plants.

A complete report^{16/} of the survey has been prepared and should be available for public distribution within the next year. The results of this survey show that the gneisses and schists, including the greenstone schist in the vicinity of Greensboro, generally furnish the largest yields. Moderate to moderately large amounts of water are obtainable. Industrial and municipal wells average about fifty gallons a minute. The best supplies are obtained in coarser phases where the dip is fairly low. The water is soft to moderately hard. Rocks of the Carolina Slate Belt appear to be second. Generally, moderately small to moderate yields (ten to fifty gallons a minute) are obtainable. Occasionally in other areas, moderately large supplies (to 300 gallons a minute) are found. The water frequently contains objectionable amounts of iron. In the granite belt the yield is generally small; sometimes moderate, and rarely moderately large supplies are found. The best supplies are from more highly metamorphosed rocks. Only a few gallons a minute are yielded by wells in unshattered rocks. The water is moderately soft to hard.

Value of Mineral Production

Due to the fact that during recent years there have been so few producers, no value of the minerals and mineral products of Guilford County can be given without revealing confidential information. Some idea of the trend can be obtained, however, from the record of past performance. The following tabulations give the value of the production of the county, the State, and the percentage represented by the country's contribution; data from the old publications of the North Carolina Geological and Economic Survey:

Value of Mineral Production Guilford County, 1901-1917

| <u>Year</u> | <u>Guilford County</u> | <u>North Carolina</u> | <u>Per cent Guilford</u> |
|-------------|----------------------------|---------------------------|------------------------------|
| 1901 | \$110,974 | \$1,779,109 | 6.2 |
| 1902 | 118,526 | 2,003,077 | 5.9 |
| 1903 | 148,783 | 1,902,485 | 7.8 |
| 1904 | 202,617 | 1,946,273 | 10.4 |
| 1905 | 154,407 | 2,439,381 | 6.3 |
| 1906 | 174,280 | 3,009,601 | 5.8 |
| 1907 | 190,986 | 3,173,722 | 6.0 |
| 1908 | 51,936 | 2,307,116 | 2.3 |
| 1909 | 190,415 | 2,783,826 | 6.8 |
| 1910 | 197,404 | 2,848,446 | 6.9 |
| 1911 | 237,415 | 2,933,878 | 8.1 |

| Year | Guilford County | North Carolina | Per cent Guilford |
|---------|--------------------|-------------------|----------------------|
| 1912 | \$273,150 | \$3,514,892 | 7.8 |
| 1913 | 281,542 | 3,879,340 | 7.3 |
| 1914 | 249,263 | 3,692,461 | 6.8 |
| 1915 | 240,291 | 3,504,725 | 6.9 |
| 1916 | 314,430 | 4,746,674 | 6.6 |
| 1917 | <u>315,301</u> | <u>5,411,452</u> | <u>5.8</u> |
| Average | \$203,042 | \$3,051,556 | 6.7 |

With the exception of 1926 when the value was \$745,695 or 6.6 per cent of the State total of \$11,274,224, no more recent county figures are available. If the 1901-1917 average be applied to the 1944 total State production of \$22,199,000, the resulting figure of \$1,487,333, which would be Guilford's proportionate share, is probably too high. This would indicate that the increase in value of mineral production of the county has not kept pace with the State increases. The geology and prevailing economic conditions have been unfavorable for an extensive exploitation and have prevented new discoveries and new developments such as have taken place in other countries. However, the possibilities of future development, particularly in the field of utilization of North Carolina minerals as the raw materials for industrial processing, should be carefully investigated and the economics determined.

It is interesting to note that practically all of the production of the county, during the present century, has consisted of clay products. In fact, from 1901 to 1908 the value of these commodities comprised 97 per cent of the county total, and the county produced almost 14 per cent of the value of the State total for these items.

Although population and area are poor bases for measurement of value of mineral production, averages on this basis are interesting. The value of the State's 1945 production averaged \$452 per square mile. On this basis, Guilford's production should have been only \$294,252, a conservative figure. Using the 1940 census figures and value of mineral production for that year, the per capita value of the State's production was \$5.91. On this basis, the Guilford County production should have been \$909,644, a figure which is probably higher than it actually was.

Need for Topographic Mapping

It is opportune to here point out that one essential to any intelligent study of the geology and mineral resources of any area is a detailed topographic map, showing drainage, culture, and relief. In fact, the industrial and economic development of any area can be greatly facilitated by such maps. The U. S. Geological Survey has for many years been engaged in completing such a topographic atlas of the entire country, in cooperation with local agencies. Some topographic mapping has been done in North Carolina, but due to lack of local interest and financial support, only a small part of the State has been adequately mapped. No part of Guilford County has been so covered.

In this mapping, the entire country is divided into quadrangles covering either 30, 15, or 7½ minutes of latitude and longitude and on a scale commensurate with the area covered. These quadrangles are named from some city or

geographical feature located therein. In the advance planning for the eventual mapping of Guilford County, the area has been recommended for mapping on the scale of 1:62,500, or approximately one inch to the mile. The following 15-minute quadrangles will thus cover the county and immediately adjacent areas; their boundaries are as shown:

| <u>Quadrangle</u> | <u>Latitude</u> | <u>Longitude</u> |
|-------------------|-----------------|------------------|
| Kernersville | 36°-36° 15' | 80°-80° 15' |
| Greensboro | 36°-36° 15' | 79° 45'-80° |
| McLeansville | 36°-36° 15' | 79° 30'-79° 45' |
| High Point | 35° 45'-36° | 80°-80° 15' |
| Randleman | 35° 45'-36° | 79° 45'-80° |
| Staley | 35° 45'-36° | 79° 30'-79° 45' |

The mapping of these quadrangles should be considered as an initial step towards the future economic and industrial development of the county. This project is estimated to cost approximately \$145,000 of which one-half would be supplied by Federal funds. Should local financial support be made available, this work could be started in the near future.

Possible Industrial Use of North Carolina Minerals

The known mineral resources of Guilford County are such that there is a certain limitation to their future development, at least until more is known regarding them. However, the establishment of plants within the Greensboro area to utilize mineral raw materials from other parts of North Carolina is limited only by the ability of manufacturers to develop local markets for the end products.

The variety of such products which might be made is indicated by a study of the mineral production of the State, present and past. The possible opportunities which are mentioned in the following pages are suggested as those which, on the basis of present knowledge, appear more worthy of investigation. Such an exposition does not constitute a recommendation for the establishment of an industry; it is a recommendation for an investigation of the economics involved as a part of any program for the economic and industrial development of the county.

The establishment of industries utilizing by-products from coking of the Deep River Coal, the expansion of the manufacture of refractories, and possible abrasive manufacture have already been discussed in some detail.

One of the most outstanding opportunities for manufacturing is that of semi-porcelain dinnerware. These opportunities have been studied in considerable detail and are discussed in the literature. One publication^{17/} sets forth the existence of a large supply of the principal raw materials in western North Carolina and another one^{18/} is an economic study which shows a definite manufacturing cost advantage for North Carolina cities over present out-of-State centers in supplying a market in the southeast which, based on income and retail trade, amounts to over \$4,000,000 annually. The availability of suitable fuel in Greensboro would increase the advantage shown in this study and the recent establishment of an art china manufacturing plant at Hickory proves the practicability of manufacture in this field of ceramics.

Another study^{19/} has indicated a potential local market for the manufacture of composition roofing in North Carolina and the availability of some of the raw materials in the State. Some of these, such as greenstone, slate, granite and other rocks found in Guilford County, might prove suitable for use as granules. The production of tar in a by-product plant in Greensboro would provide another one and would indicate Greensboro as a possible location for a plant for such manufacture.

In the field of drug manufacture the phenomenal success of the Vick Chemical Company has set an excellent example. Several possibilities are suggested for the utilization of North Carolina minerals in drug and chemical manufacture. Among these the most outstanding ones are the use of olivine occurring widespread in several western counties in the manufacture of magnesium sulphate (epsom salts) and other magnesium drugs and chemicals. The extensive spodumene deposits in Gaston and Cleveland Counties^{20/} constitute a lithium ore which might find a ready utilization for drug manufacture. The same is true of the barium sulphate (barite) occurrences in Gaston, Orange, and Madison Counties.

Paint manufacturing industries utilizing North Carolina pigments and fillers deserve investigation. The titanium pigments have been mentioned; North Carolina is the largest producer of ground mica in the United States and this mineral, as well as talc and pyrophyllite, seems to offer definite possibilities for a local manufacture.

Insecticide manufacture should find a ready local market. This could utilize pyrophyllite, a hydrous aluminum silicate now being mined in counties adjacent to Guilford, or vermiculite, an altered chlorite being produced in Macon County, which would constitute excellent carriers.

The manufacture of fertilizer is now an established industry in Guilford County. The availability of ammonium sulphate through the coking of the Deep River Coal will broaden such manufacture. It is believed that fertilizer manufacturers could utilize a greater quantity of North Carolina minerals as fillers. Among these are marl, limestone, and shales which occur with the coal in Deep River and are quite rich in nitrogen and phosphorus.^{21/} Magnesium sulphate has also been proven an excellent fertilizer for some purposes.

The establishment of pre-fabricated concrete manufacture offers an opportunity for the utilization of vermiculite in a light-weight concrete which possesses excellent insulating qualities.^{22/} Some recent experiments have indicated that the shales of the Deep River Coal Field, and possibly these of the Dan River Field, might prove suitable for the manufacture of expanded light-weight aggregates which would find a local utilization in Guilford County and possibly in making pre-cast concrete for shipment to adjacent areas.

Another possible opportunity in the field of insulating materials is rock wool manufacture. It is believed that a blend of granite screenings and marble waste or limestone would provide suitable raw materials. An

undeveloped limestone deposit in Yadkin County gives some promise of being a natural wool rock. Greensboro seems to be a logical locality for a rock wool plant, particularly if cheap fuel be available. There would be an ample marketing territory throughout North Carolina and adjacent areas.

It is here emphasized that opportunities for the utilization of mineral raw materials are not fixed by any traditional manufacturing trends. The picture is one of continual change and progress; new mineral discoveries and technological advances constantly tend to develop new uses for minerals and make commercial some mineral which previously has been only a mineralogical curiosity. This indicates the need for a periodic review of the situation in the light of new developments, both economic and technological.

A Development Program

It has been demonstrated that industrial developments follow in the wake of basic geologic research. Most of the mineral industries in North Carolina are the result of such research, complemented in some cases by technological investigations. A practical program of both is being carried out by the Division of Mineral Resources of the N. C. Department of Conservation and Development and those agencies, both Federal and State, with which it has cooperative agreements, both formal and informal. However, such a program is necessarily confined to immediate and urgent requirements and an overall coverage of the State must, if only for budgetary reasons, extend over a period of years and must yield the greatest good for the greatest number. Any acceleration of such a program and the application of the same to areas of a greater future potential importance can be made possible only through a direct financial support of local organizations. This local cooperation and interest must not cease with a determination of the basic factual information; local capital must be ready to undertake recommended developments to obtain additional information and to carry out experimentation and investigation which is obviously outside the scope of a government agency. County planning agencies can well utilize the services of an experienced engineer who is grounded in the geology of mineral raw materials, their processing and marketing, to cooperate with local capital and industry in the appraisal of individual projects suggested after the more basic information has been obtained by the State organization within whose field such a basic investigation lies.

The North Carolina Department of Conservation and Development stands ready to assist interested persons and local organizations in any pertinent phase of the economic development of Guilford County. The Mineral Resources Division is prepared to cooperate in the planning and administration of any detailed investigation of the county's resources, or in the location of a source of supply of mineral raw materials in other areas for industrial utilization by Guilford County industries. The Division of Commerce and Industry is likewise prepared to cooperate in a determination of the economics attending any proposed industrial development.

Conclusion

The economic minerals of Guilford County include granite, gold, and titaniferous magnetites. Some clay deposits have been exploited, and there are indications of the occurrence of emery. Additional information is needed regarding all of these minerals to permit any planning for future development. The major part of past production has consisted of clay products, and a large plant at Pomona processes shales from an adjacent area. The development of the Deep River Coal Field and establishment of a by-product coke plant in Greensboro will provide raw materials and fuel for new industries which will be favorably situated with respect to markets. The possibilities of new industrial developments in the county to utilize mineral raw materials of the State appear promising. Those manufacturing ceramic ware, refractories, abrasives, drugs and chemicals, roofing, fertilizers, insecticides, and building insulation appear most worthy of detailed investigations.

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