GROUND-WATER PROGRAM in ALABAMA

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Several recent years of drought have emphasized the importance of Alabama's ground-water supplies, a matter of concern to us all. So far we have been blessed in Alabama with ample ground water, although a combination of increased use, waste, pollution, and drought has brought about critical local water shortages. These problems serve as a fair warning of what lies ahead if we do not take the necessary steps to obtain adequate knowledge of our ground-water resources.

The availability of water controls the development of an area. It is important to the expansion of a city or industry, to the development of a new industry, or to an irrigation project; it is important to raising stock and to the development of other farm and domestic water supplies. Where available, ground water is often used because of its constant year-round temperature, large underground storage reservoirs, and low cost of development and maintenance. Because of these advantages, there has been a steady increase in the amount of water withdrawn from the ground in our State. Problems have developed, and the past year's drought has greatly aggravated the overall situation. Fortunately, to date, our ground-water problems have been localized in industrial and municipal centers and in areas of artesian flow. It is encouraging that in many areas of Alabama there are still large quantities of ground water that can be developed to meet the growing demands. **The problem is to obtain an adequate inventory of our ground-water resources and use this knowledge in their proper development and conservation.** We need to know how much water is available, where and how it occurs, and what its quality is. Such information would be very helpful in development of remedial measures for prevention of waste and wise use of ground water.

Need for Ground-Water Facts

To obtain needed ground-water facts, the Geological Survey of Alabama cooperated as early as 1898 with the U.S. Geological Survey on ground-water studies. Alabama's first ground-water reports were prepared by Dr. Eugene Allen Smith, state geologist, and were published

in U.S. Geological Survey Water Supply Papers 102 and 114. Another report, "The Underground Water Resources of Alabama," was published as Alabama Geological Survey Monograph 6 in 1907.

A reconnaissance study of 25 counties in the northern part of the State was made by W. D. Johnston, Jr., and published in 1933 as "Ground Waters of Northern Alabama," Special Report 16, (Figure 3). With the completion of this work, ground-water studies were discontinued until 1940.

The present series of investigations were begun in 1940 and have resulted in the completion of reconnaissance ground-water studies for the entire State. Detailed studies are completed or in progress in 12 counties (Figures 1, 2, and 3). Not only has the scope of the program increased over the past 15 years, but data are now available for better evaluation of the needs for ground-water studies in the future. In addition to cooperative state funds, supplemental local funds were made available for studies of some of the more pressing water problems such as those at Huntsville, Montgomery, Monroeville, Choctaw County, and other areas.

Our water problems, however, have grown with the increased use of water, and each additional year of drought has emphasized more clearly the need for complete information on our ground-water resources. New problems are continually developing in Alabama; for example, water levels have declined in some municipal and industrial areas of concentrated pumping from wells and in some areas of artesian flow. Problems in some areas of the State last year became so acute that it became necessary to curtail use of water, and property worth millions of dollars was endangered because water was inadequate for fire protection. Facts on ground water have not always been available to answer adequately all requests for information, although an attempt has been made to supply the best data available. To illustrate the need for water facts, during the peak of the drought in 1954 the U.S. Geological Survey, in cooperation with the Geological Survey of Alabama, received and answered 80 requests from municipalities, 117 requests from industries, 39 requests from State and Federal agencies, and 208 requests from private parties, including 53 requests for irrigation data. Figure 4 illustrates the increase in requests for ground-water data since 1947, and Figure 5 shows the areal distribution of the requests received in 1954 and emphasizes the need for basic ground-water facts for the entire State. These illustrations show also the increase in requests for information to aid development of water for irrigation. Prior to 1953 few requests were received regarding irrigation supplies, and those received were included in another classification. Now data on water for irrigation are among those for which the greatest number of requests are received.

Geology and Occurrence of Ground Water

To understand adequately the occurrence and availability of ground water in any area, it is necessary to know the origin, character, and structure of the rocks and to plot these characteristics on a map. It is necessary also to study existing wells and springs in an area. Where existing data are inadequate, supplemental test drilling is needed. Also representative wells are chosen, water levels measured, and water samples collected periodically. From these data water-table maps are constructed to show recharge areas and direction of movement of ground water. Key wells must also be test pumped to determine the hydrologic characteristics of the aquifers. These facts can, in turn, be used to predict the quantity of water available from the water-bearing beds. After these basic facts are collected and evaluated, they are placed in report form and made available to the public to aid in development of municipal, industrial, irrigation, stock, and domestic water supplies and to aid conservation of the ground-water resources.

The State of Alabama includes three major geologic divisions: the Piedmont; the Appalachian Ridge, Valley, and Plateau; and the Coastal Plain (Figure 6). Each division has different geologic formations and structure, and therefore different water-bearing characteristics.

The rock formations in the Piedmont in east-central Alabama are metamorphic rocks, mainly crystalline schist and gneisses intruded by younger igneous rocks, such as granite (Figure 6, area I). These formations are folded and faulted, and have a complicated structure. They are the oldest and among the most complex rocks in Alabama and in the United States. Generally, only small or moderate yields up to about 50 gallons per minute are obtained from wells in this area; however, in some localities, larger supplies can be developed. The development of water in this area is aided by a knowledge of rock type, structure, existence of veins, fracturing, and topography. In this area test drilling is necessary to develop the best water-bearing openings. There are a few localities in the Piedmont where adequate ground-water supplies can be developed for supplemental irrigation, among these are some of the alluvial areas adjacent to the large streams. See Figures 2 and 3 for references to specific data for this area.

The rocks of the Appalachian Ridge, Valley, and Plateau consist chiefly of shale, sandstone, limestone, and dolomite which aggregate many thousands of feet in thickness (Figure 6, area II). In the eastern part of this region the rocks are complexly folded and faulted; in the western part they are nearly flat lying, dipping gently to the south. Many water supplies in this region are derived from wells developed in, or springs issuing from, fractures, or solution cavities in the rocks. The development of large quantities of ground water in the southwestern part of this region is more difficult and more expensive than in the northern and eastern valley areas of the region. The valley areas along the Tennessee, Cahaba, Wills, and Coosa Rivers are, for the most part, underlain by massive limestones. Large springs such as at Huntsville and Tuscumbia issue from openings in limestone and flow millions of gallons of water a day. Throughout this area, there are many wells that will supply more than 200 gallons a minute and some that will supply 1,000 gallons or more a minute. Much expense and time can be saved in planning and carrying out ground-water developments by knowing the geologic structure and type of rocks and their water-bearing properties. By use of these basic facts in guiding an efficient test-drilling program, the development of large quantities of water can be accomplished in many parts of northern Alabama, especially in the Tennessee and other valley

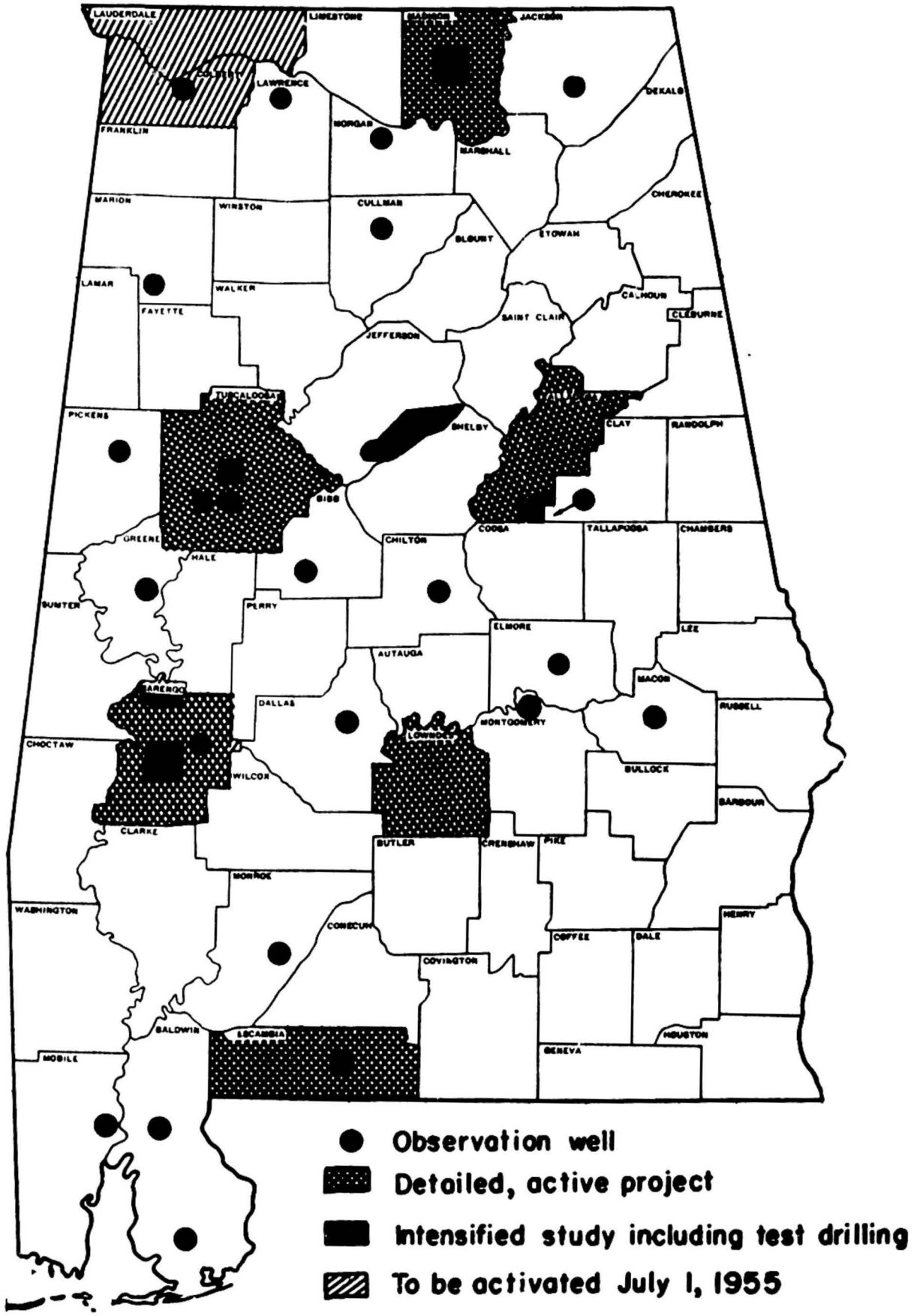

Fig. 1. Ground-water projects in Alabama.

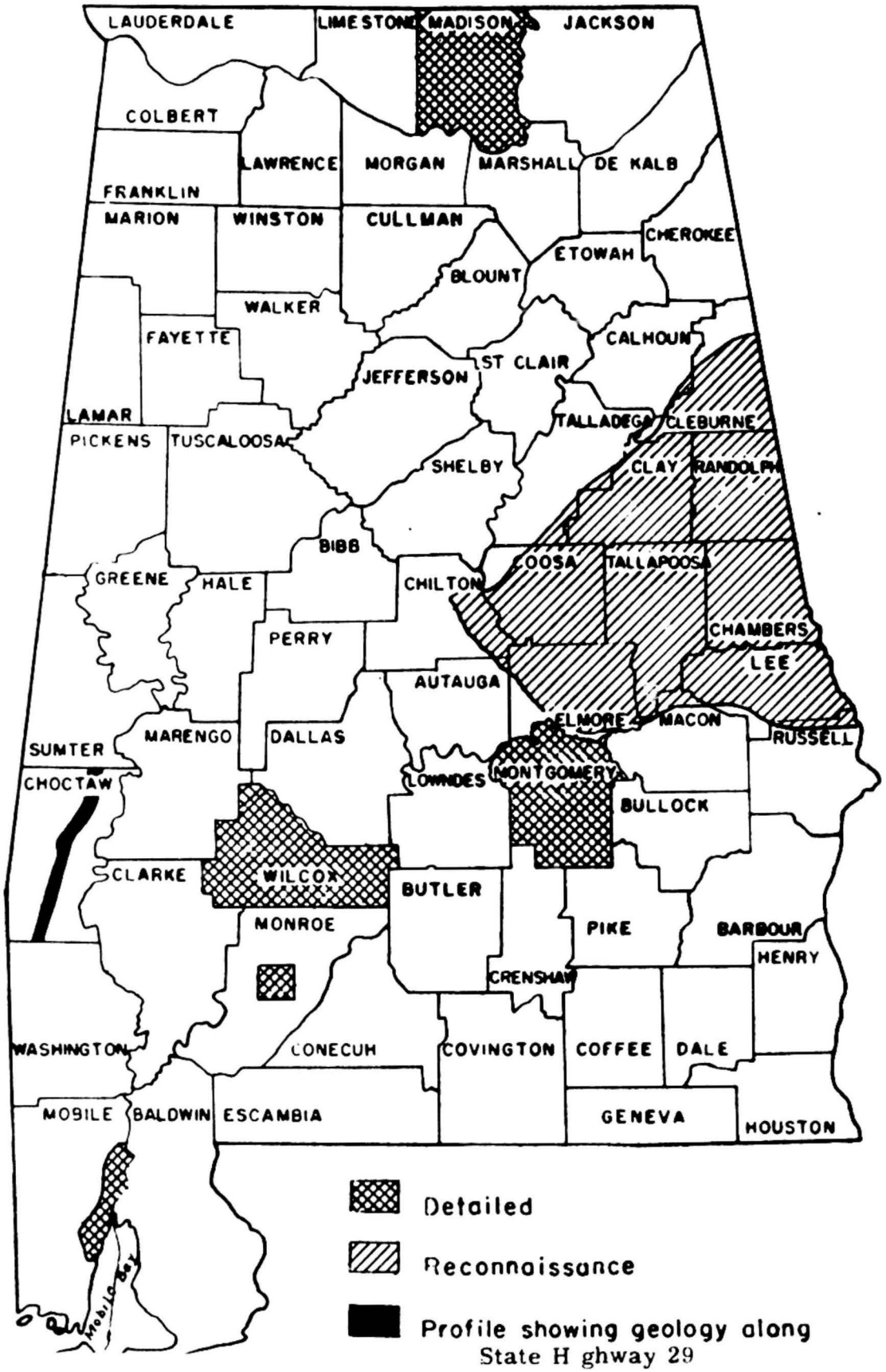

Fig. 2. Publications in preparation

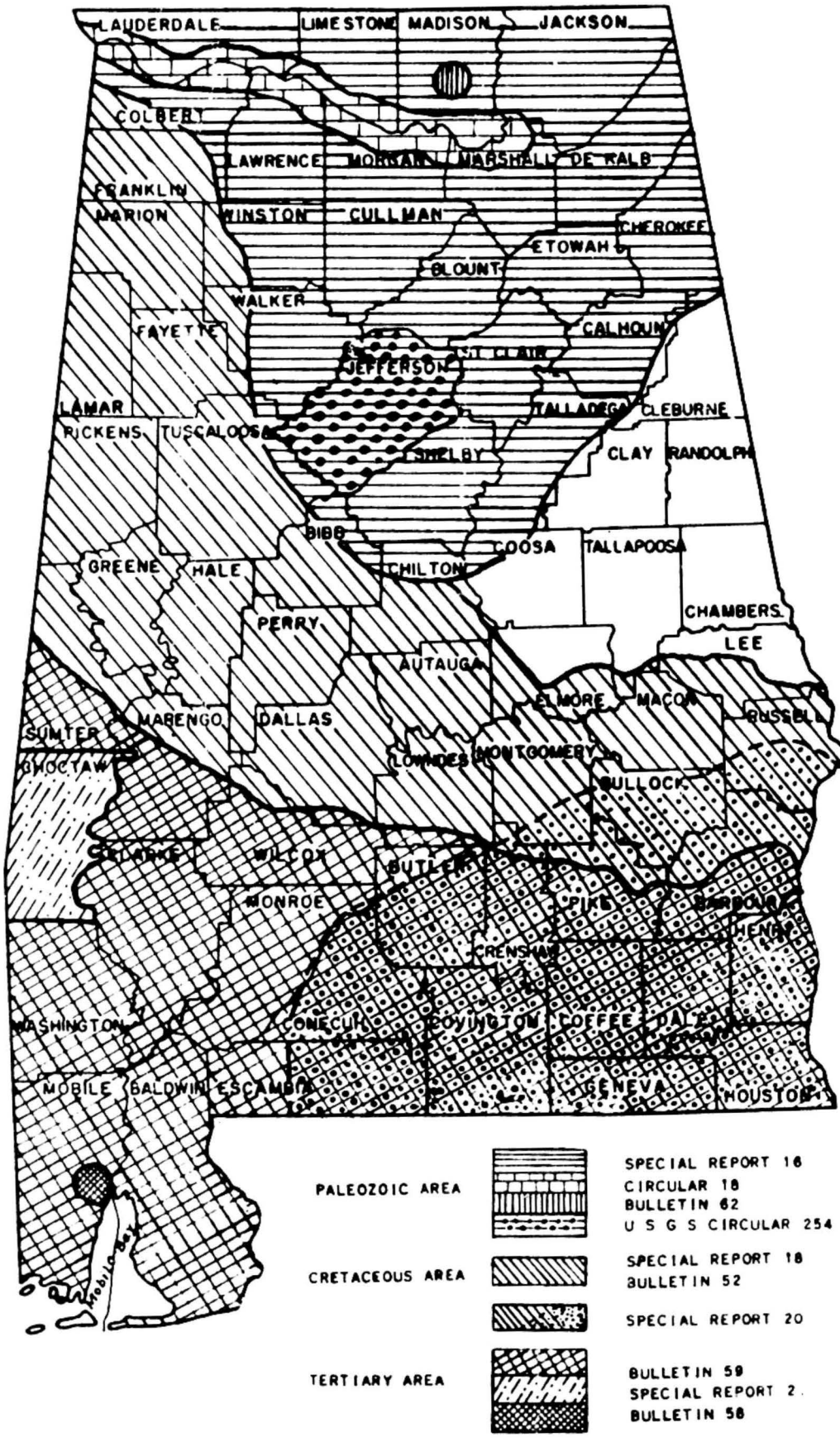

Fig. 3. Areas in Alabama covered by ground-water reports.

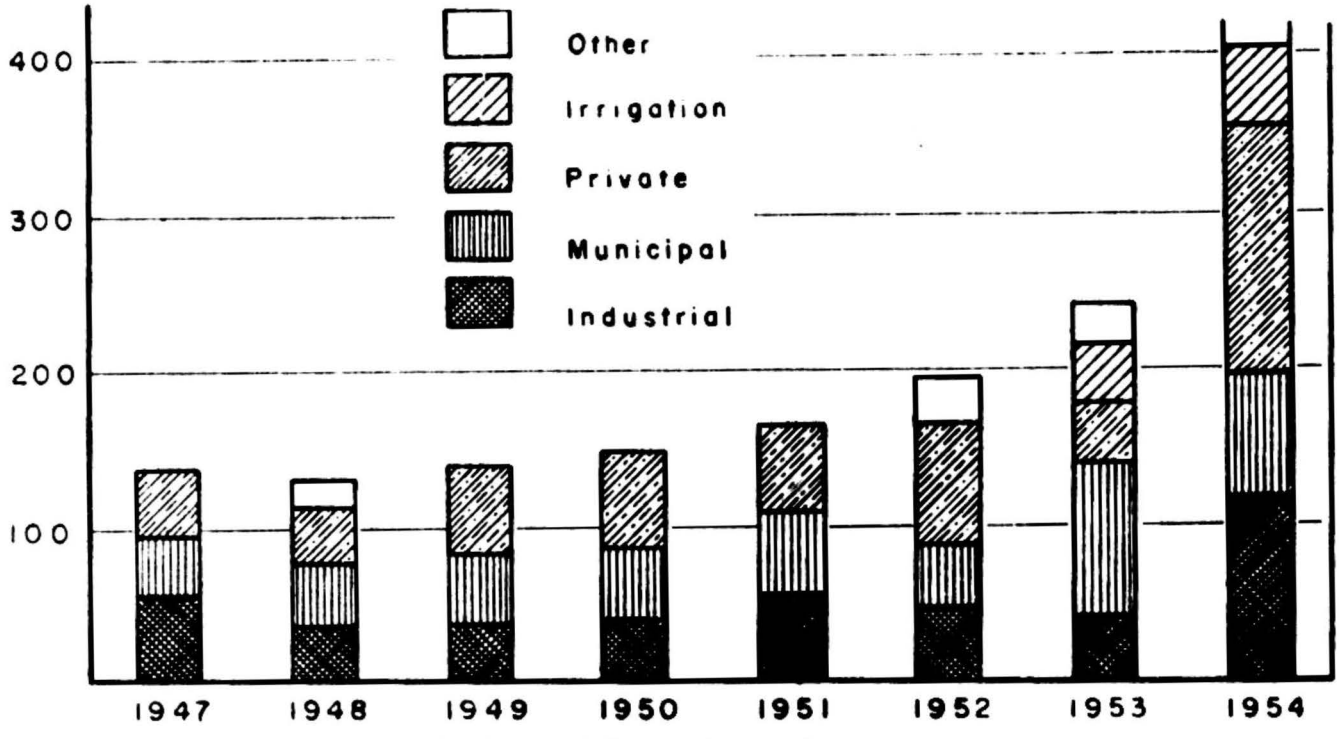

Fig. 4. Requests for ground-water information.

areas. (See Figures 2 and 3 for references to specific data for this area.)

The Coastal Plain in the southern half of the State is underlain by gently southward dipping beds of clay, sandy clay, sand, gravel, marl, and limestone (Figure 6, area III). Some of the sand beds are sources of large quantities of good quality water that can be developed by properly constructed and spaced wells. No generalized "rule of thumb" can be used to develop this water, because the depth of the water sands, the quantity and quality of water, and the water levels vary throughout the region. Specific local data on geology, hydrology, and quality of water are essential to aid the safe development of large quantities of water from wells; with this knowledge much additional water satisfactory for municipal, industrial, domestic, and irrigation and other agricultural uses can be developed in most of the Coastal Plain. Proper care and planning of these developments are necessary, however, for large development of water at one place will influence water levels in wells at considerable distances. (See Figures 2 and 3 for references to specific data for this area.)

In the areas adjacent to the streams throughout the State are alluvial deposits of clay, sand, and gravel overlying all the older rock formations. At many localities these sand and gravel beds are an excellent source of large quantities of water of good quality. Where these beds are near perennial streams and can be recharged by them, induced infiltration could be brought about by proper construction and spacing of wells. To date, these sources of ground water are relatively undeveloped in the State.

In some areas in Alabama, the development of large quantities of water from wells may greatly influence existing municipal, industrial, or other wells. In some areas, pumping water from wells will affect the flow of streams. Well development practices that are satisfactory in one area may not be efficient in others; construction practices will have to vary from place to place with geology and the occurence, quality, and quantity of ground water. If large irrigation or industrial developments of water are carried out without consideration of existing supplies, depletion of ground-water reservoirs requiring costly remedial measures could take place.

Any irrigation development should be based on the best water facts available and should include the collection and recording of specific data to aid future planning. We must collect accurate information on location and construction of wells, logs of wells and samples of drill cuttings, adequate pumping test data to determine the quantity of water available and the type and capacity of pump needed, and periodic water level measurements to show the influence of the development.

Collection of data from irrigation and other water development projects, when evaluated with data collected from the water-resources investigations, will be of immeasurable help in the development and conservation of ground water in the State.

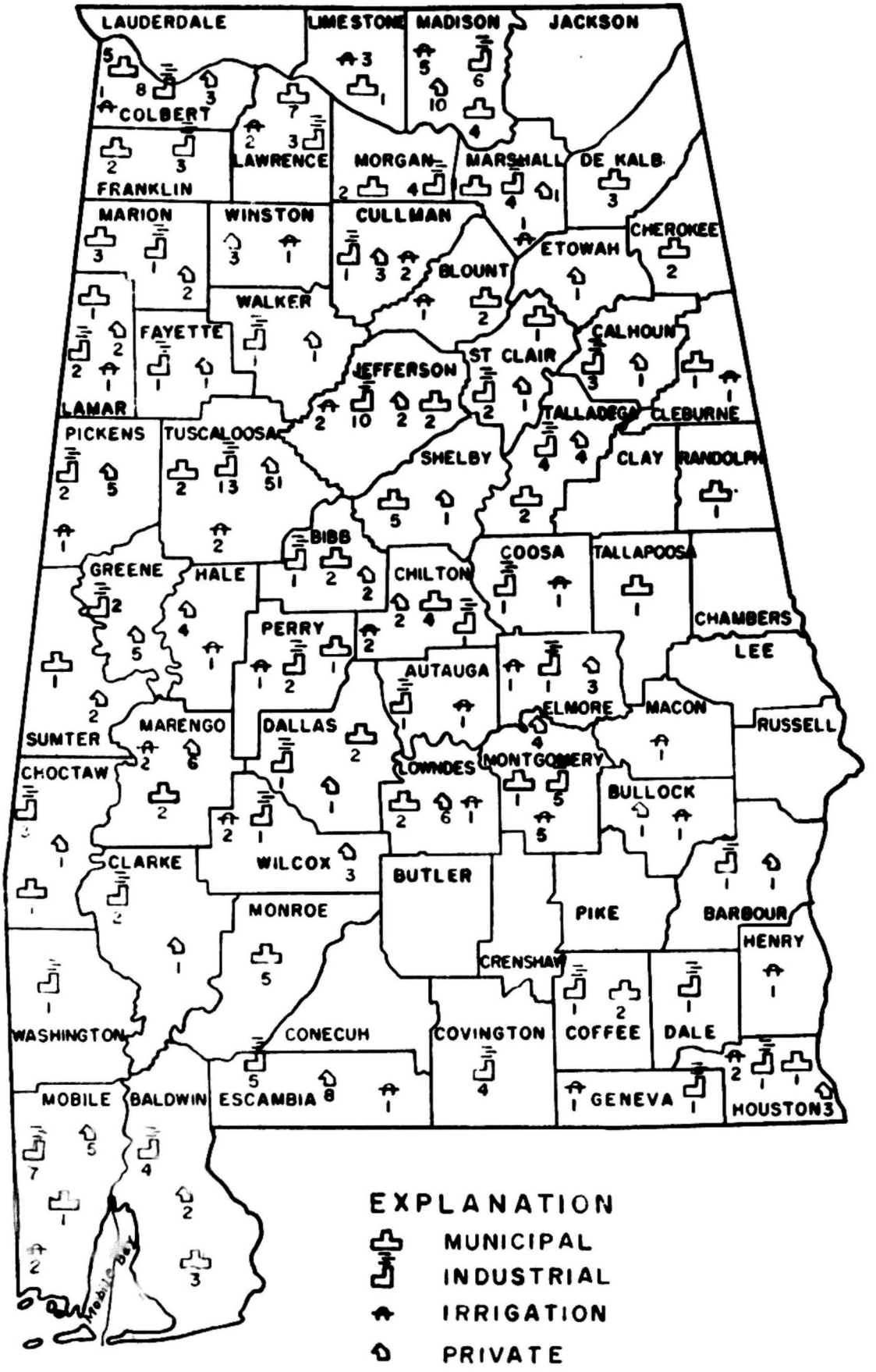

Fig. 5. Number of requests for ground-water information received during 1954 by counties.

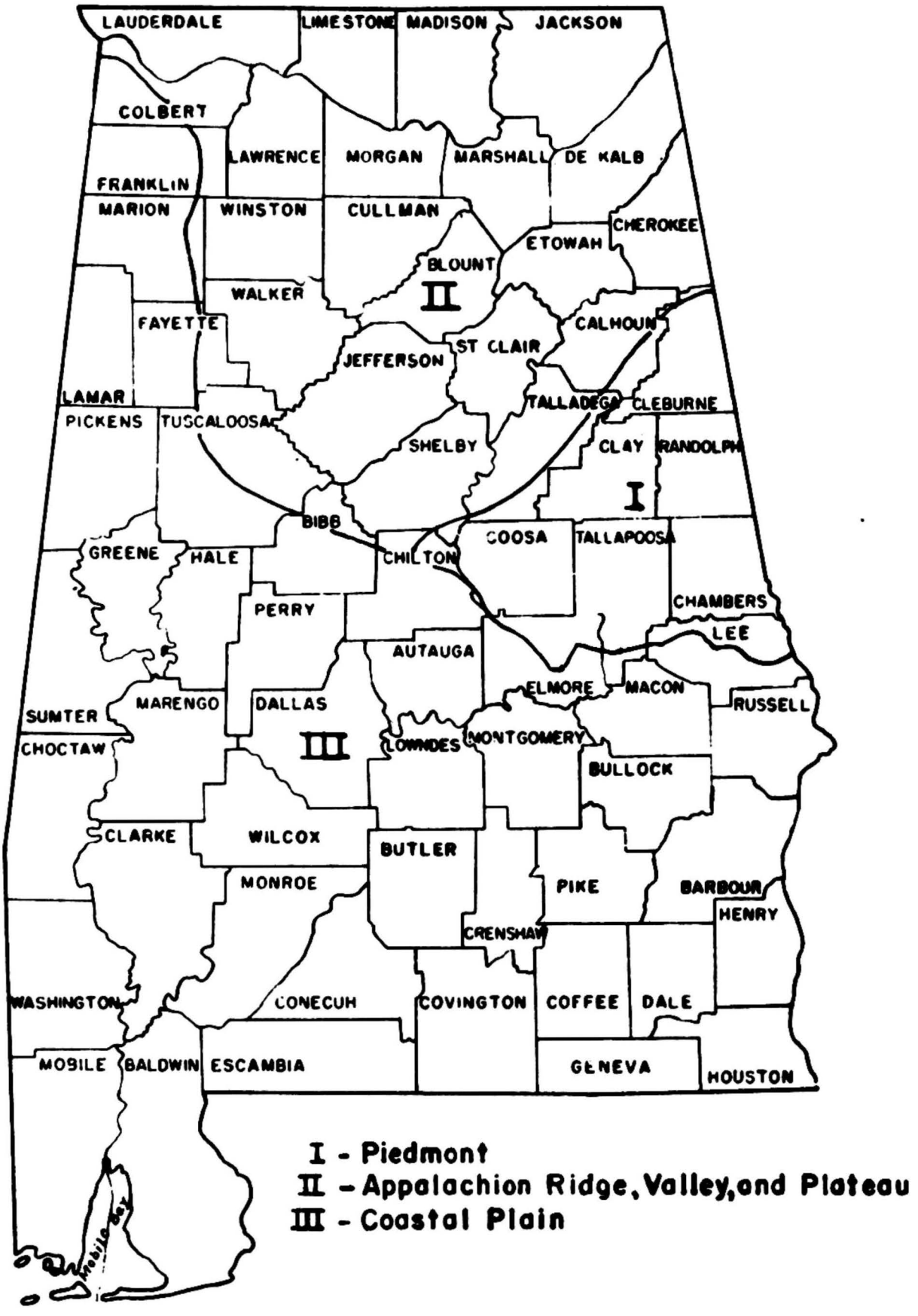

Fig. 6. Geologic provinces of Alabama.

Available Ground-Water Facts

The program of ground water investigations in Alabama by the U. S. Geological Survey and the Geological Survey of Alabama has been directed to supply, so far as financially possible, the needs for geologic, hydrologic, and quality-of-water information to aid development of municipal, industrial, agricultural and domestic water supplies and to collect information on this essential resource. Because of the close relationship between geology and the occurrence of ground water, the program in Alabama has been developed as follows: (1) representative detailed county investigations are being made in the different geologic provinces of the State, (2) comprehensive studies are being undertaken as a result of critical shortage or depletion of ground-water supplies; (3) reconnaissance studies are being made in broader areas where available basic data are scarce but the demand for them is great, and (4) some studies are related to the national defense as at the Huntsville guided missiles center and Maxwell Air Force Base at Montgomery.

Studies are badly needed and will be undertaken in Mobile, Baldwin, Dallas, and Houston Counties, throughout the Tennessee Valley area, and in all the artesian-basin areas. Detailed county studies will be continued until eventually the whole State is covered by adequate ground-water information. Projects under way are shown in Figure 1. Projects recently completed for which reports have been written and are in the process of publication are shown in Figure 2. Projects completed for which ground-water reports are available are shown in Figure 3.

In addition to published reports, there is on file in the Tuscaloosa Ground Water office specific data on several thousand water wells over the State. These data when evaluated with the available geologic information may be used to aid ground-water development in many areas of the State not covered by published reports. This information is available for specific localities on request.