# MISSISSIPPI
# STATE GEOLOGICAL SURVEY

WILLIAM CLIFFORD MORSE, Ph. D.
Director

BULLETIN 56

# GEOLOGY and GROUND-WATER SUPPLY AT CAMP VAN DORN

By

GLEN FRANCIS BROWN, M. S.

and

WILLIAM FRANKLIN GUYTON, B. S. C. E.

In cooperation with the
United States Geological Survey

UNIVERSITY, MISSISSIPPI
1943

Please do not destroy this report; rather return it to the Mississippi Geological Survey, University, Mississippi, and receive postage refund.

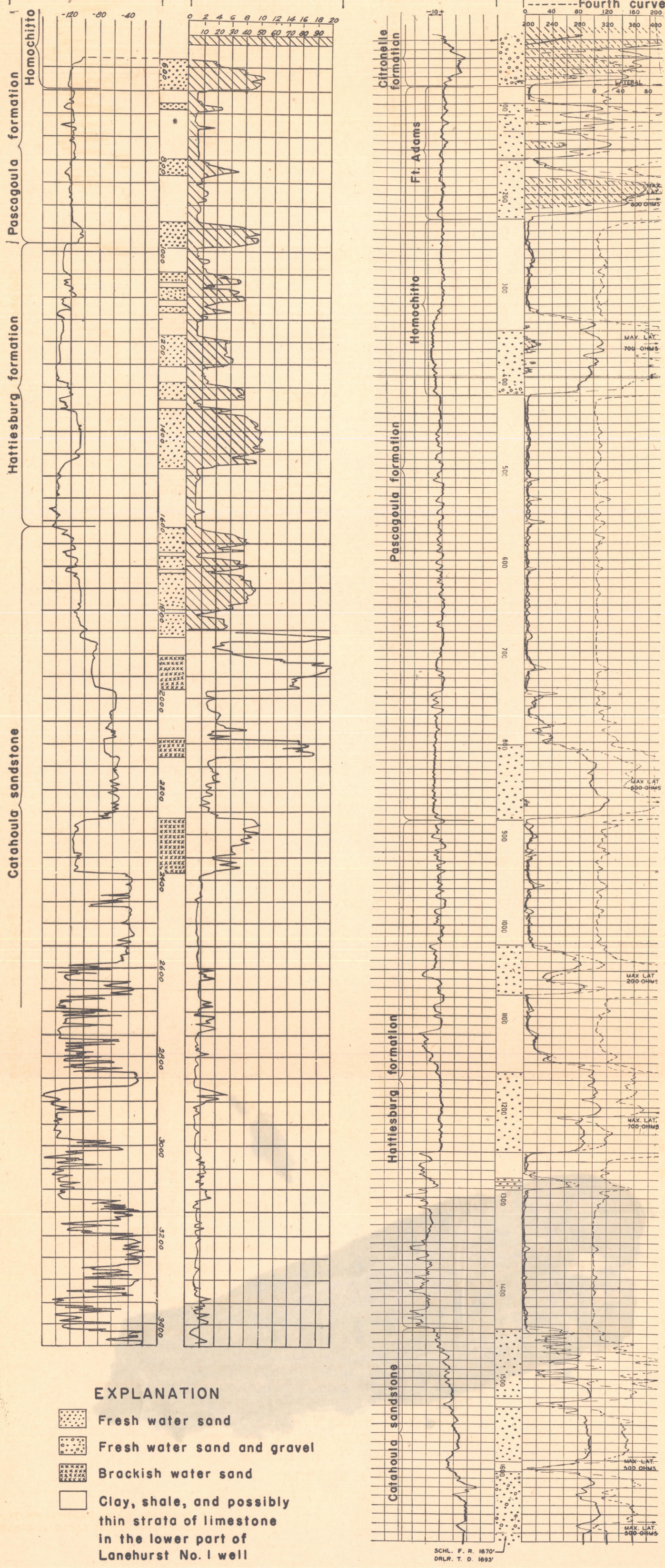
# PLATES 1 & 2

## ELECTRICAL LOGS OF UPPER PART OF KIRBY PET. CORP. LANEHART NO. 1 AND CAMP VAN DORN TEST WELL 3

Wilkinson County, Mississippi

Showing the depth of the bottom of fresh water in the region and the stratigraphic units as interpreted by G. F. Brown

| LANEHART NO. 1 | CAMP VAN DORN TEST WELL 3 |
|---|---|
| 392 ft. SW of SW corner sec. 21<br>T. 1 N., R. 2 W.<br>Altitude 319± ft.<br>Observer - Gillingham<br>May 18, 1935 | SW $\frac{1}{4}$ sec. 3, T. 1 N., R. 1 W.<br>Altitude 356 ft.<br>Observer - R. K. Theis<br>March 31, 1942 |




## EXPLANATION

- Fresh water sand
- Fresh water sand and gravel
- Brackish water sand
- Clay, shale, and possibly thin strata of limestone in the lower part of Lanehurst No. 1 well

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## MISSISSIPPI GEOLOGICAL SURVEY

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* On military leave

# LETTER OF TRANSMITTAL

Office of the Mississippi Geological Survey
University, Mississippi
November 24, 1943

To His Excellency,
Governor Paul Burney Johnson, Chairman, and
Members of the Geological Commission

Gentlemen:

Herewith is Bulletin 56, Geology and Ground-Water Supply at Camp Van Dorn. It is a report to the U. S. Army Engineers summarizing the results of special field and laboratory investigations of a water supply for a camp of thousands of men in training for the armed force.

The investigation of the water supply for Camp Van Dorn, like the investigation of the water supply for Camp McCain (Bulletin 55), is the result of cooperation between the U. S. Geological Survey and the Mississippi State Geological Survey and was undertaken at the request of the War Department which allocated funds to supplement the joint cooperative budget of the Federal-State ground-water survey of the state as a whole.

Although the investigation of a water supply for Camp Van Dorn, like the investigation of the water supply for Camp McCain, is of a small area, the study, likewise of necessity, extended toward the north, the area described by members of the Mississippi Geological Society and the collecting area of the ground water beneath the camp. And although the investigation is of a specialized area, nevertheless it constitutes a part of the cooperative ground-water investigation of the state as a whole. And although the investigation involved field and laboratory research for a number of months, the conclusions involve the fruits of ground-water investigations of the state as a whole for a period of more than five years by Glen F. Brown, the geologist in charge.

The investigation resulted in an abundant water supply for Camp Van Dorn: the water in six of the nine wells is coming from the Homochitto sand of the Pascagoula formation, the water in one well is from the overlying Fort Adams sand of the same formation, the water in still another well is from the underlying Lower sand of the same formation, and the water in the ninth well is from the deep Catahoula formation.

Not only has the investigation of the Geology and Ground-Water Supply at Camp Van Dorn materially increased the scientific information about

ground-water supply, but it has likewise, it is hoped, increased the scientific knowledge of the subsurface geology of this part of the state—information of value in the present search for oil. In this connection special reference should be made to the Homochitto structure map (Plate 5), which shows a southwestern-dipping structural or depositional terrace beneath the camp, even though north and west of the camp the regional dip is southeast. Either the regional structure changes radically within a few miles or a local structural high favorable to oil accumulation is present northeast of the camp. Such shallow indications of suitable petroleum reservoirs are of value, as shown by the recent discovery of petroleum at the California Company No. 1 National Gas Company of Louisiana in eastern Adams County where Franklin Earl Vestal, in Bulletin 47 Adams County Mineral Resources (April 1942), had previously described on page 71 favorable surface indications for the accumulation of oil and gas and recommended on page 89 that this structure be tested.

Very sincerely yours,

William Clifford Morse,
State Geologist and Director.

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# GEOLOGY AND GROUND-WATER SUPPLY AT CAMP VAN DORN

By

Glen Francis Brown and
William Franklin Guyton

## ABSTRACT

The water supply at Camp Van Dorn is from nine wells whose screens are set in four different geologic beds. The presence of these subsurface beds was determined from information gained by drilling a test water well (number 3) to a depth of 1,700 feet, surveying the hole by the customary electrical logging method, and testing and studying the rotary cuttings. The stratigraphic descriptions are based on the electrical log, a study of the mineralogy of the rotary cuttings, the quality of the ground water in the various aquifers, and the surface work of members of the Mississippi Geological Society.

The lower limit of fresh water in this area is shown on electrical logs of oil prospect borings to be the non-marine and irregularly distributed sands in the upper part of the Catahoula sandstone (Miocene), which was encountered at a depth of 1,445 feet at test well 3, the only well developed in the Catahoula sandstone at the camp.

A stratigraphic section above the Catahoula sand and within the depth interval of 885-1,445 feet in test well 3 is believed to reveal beds equivalent to the Hattiesburg clay of Miocene age. Fresh water is found in the fine-grained sands of this interval but present well construction methods preclude development.

The remainder of the statigraphic section, above the Hattiesburg clay and beneath the terrace deposits that cap the ridges, is considered to be the equivalent of the Pascagoula clay, also of Miocene age, and to be approximately 900 feet thick at the camp. A sand at the base of this Pascagoula formation is developed in one well at pumping station 9. The upper part of the Pascagoula formation is divided into two members: the Homochitto and the overlying Fort Adams. Of the remaining seven wells, six are constructed in a sand at the

base of the Homochitto member and one is constructed in a sand in the lower part of the Fort Adams.

At pumping station 1, the static water level of the Catahoula sand is 238 feet beneath the surface; of the Homochitto sand, 45.5 feet beneath the surface; and of the Fort Adams member, 43 feet beneath the surface. At pumping station 9, the static water level of the basal sand of the Pascagoula formation is 225 feet beneath the surface.

Pumping tests indicate that the coefficients of transmissibility of the sands range from a maximum of about 1,000,000 gallons a day in the well developed in the Catahoula sand to a minimum of 3,900 gallons a day in the well developed in the Fort Adams member of the Pascagoula formation. The coefficient of transmissibility of the basal sand of the Pascagoula appears to be on the order of 99,000 gallons a day, compared to an average coefficient for the Homochitto wells of 45,000 gallons a day. The average coefficient of storage of the Homochitto sands is 0.00037. The tests of wells in the Homochitto sand show that they are capable of yielding more than present camp supply and that the controlling factor to determine additional supply is pump capacity. The decline of water levels by present pumpage may require that a few pump bowls be lowered at the end of 3 years. Fine sands and comminuted clay in the Fort Adams account for the low yield from this member. Although the lower few feet of the terrace sands and gravel are saturated with water, the streams have cut beneath the base of the deposits, causing abundant effluent seepage.

The Catahoula sandstone contains much orthoclase feldspar, whereas microcline is abundant in the Hattiesburg and Pascagoula formations. Siderite is abundant in the marine facies of the Hattiesburg and Pascagoula formations; glauconite less so. The shallower sands contain many opaque iron minerals, as magnetite and hematite, and are separated from the lower zones containing pyrite by a zone wherein marcasite seems most abundant. There is some evidence that similar zoning is in the Catahoula sandstone.

The quality of water is reflected somewhat in the resistance curves of the electrical log, but the known static levels and the chemical analyses of water from the four sands show that some extraneous effect is needed to explain the differences in self-potential. The most likely explanation seems to be that a natural self-potential existed between the sands and the clayey sediments prior to drilling. Such natural potentials might be the result of ground-water movement.

The calcareous beds in the lower part of the Pascagoula yield water which is nearly neutral (pH 6.9) and contains very little iron, whereas the non-marine beds in the Catahoula and the upper part of the Pascagoula formation yield water which contains free carbon dioxide and iron in solution, even though all the waters are low in total dissolved solids and are soft.

## LOCATION

Camp Van Dorn in southwestern Mississippi is south and east of the town of Centreville in Wilkinson County, although the artillery ranges and the hospital area extend eastward into Amite County. The camp site is about 70 miles from Baton Rouge, Louisiana, and about 47 miles from McComb, Mississippi.

## TESTING AND SAMPLING METHODS

### TEST DRILLING

The potential ground-water supply at the site was tested by a well drilled by the rotary process to a depth of 1,699 feet. Samples of the cuttings were obtained from the sludge ditch following each interval of fluid circulation, which in turn followed the drilling operation for each joint of drill stem. As the hole became deeper, the time for complete circulation increased until an hour was required near the end of the test. The drilling fluid was circulated through a wooden trough with baffles and, when a sand capable of yielding water was cut, an attempt was made to obtain a quantitative sample by channelling so spaced as to represent a true fraction of all the material in the ditch. A sample of sand and mud obtained in this manner was thoroughly mixed and a part was retained for laboratory analyses. The trough and ditch were then cleaned, preparatory to collecting the cuttings for the next depth interval.

Accurate sampling of rotary cuttings is always difficult; therefore the several factors that determine the purity of the sample should be evaluated. Of these factors, the behaviour of the drill is usually considered important, and when the behaviour of the drill changes, the thickness of the stratum between changes is determined by measuring the length of the "kelly" above the rotary table. When sand is encountered the drill column will usually rotate loosely and the fluid pressure will remain constant or decrease. Progress down-

ward is accelerated and goes forward in a series of jumps. If considerable clay is present the rotary drill chain will probably remain taut and the fluid pressure will tend to increase. Drillers also take into consideration the amount of mud fluid absorbed by the aquifers. The consumption is measured by marking the level of the fluid in the sludge pit when the sand is encountered, then noting the decline of the fluid level in the pit as drilling progresses. This measurement alone is probably of doubtful value in determining the absorption of the sand, because penetration of the mud fluid is controlled not only by the permeability of the sand but also by the difference of hydraulic pressure between the natural hydrostatic pressure on the sand on one hand and the weight of the column of mud fluid and the pump pressure on the other. Thus it is easy to imagine two water-bearing sands under different natural hydrostatic pressure and of different permeability, yet each absorbing the same amount of drilling fluid. Conceivably a more desirable sand might absorb less mud than a less desirable sand.

The driller at the test well attempted to hold the fluid weight between 9 and 10 pounds per gallon (1.08-1.20 specific gravity) by adding water as clay or shale was encountered and by adding mud or lime (if needed) after drilling through sand. Near the end of the test lime was added to the drilling fluid until the specific gravity was 1.21. The mud pump was a horizontal centrifugal type, powered by a gasoline engine with a set throttle so that most of the time the pressure was maintained at about 80 pounds. On the whole this type of pump probably furnishes a better sample than the piston type pump which reaches much higher pressures. Excessive pressure undoubtedly increases contamination of the sample from material derived from the higher walls of the hole, but, conversely, a constant low pressure may not furnish sufficient force to wash out the larger grains of sand or fine gravel loosened by the bit. Increasing the specific gravity of the drilling fluid is probably the best way to counteract the deleterious effect of low pump pressure in a coarse sand.

## ELECTRICAL LOGGING

One method used to check the accuracy of the drillers log and of the sampling at test well 3 was the electrical log or electrical coring as developed by a commercial firm specializing in such surveys for oil and gas companies. Immediately after completing the hole a

multiple electrode was lowered to a depth of 1,670 feet by means of a conducting cable and winch mounted on a truck. Grounding near the collar of the well completed the electrical circuit. As the electrode was raised from its position near the bottom of the hole, the self-potential or natural electromotive force and the resistance of the strata to an induced current were automatically and simultaneously recorded on a film (Plate 1) exposed to the oscillations of the potentiometer and the galvanometer. The normal resistivity curve on the right side of the film indicates mostly the resistance of the interstitial water. A shale or salt water sand offers low resistance, and a permeable fresh water sand or an indurated rock offers high resistance. Thus porous sands containing fresh water offer higher resistance than less porous fresh water sands. The third and fourth curves are essentially the same as the second or normal curve, except that the distances between electrodes in the well are 39 inches and 15 feet instead of 10 inches for the spacing of electrodes for the second or normal curve. Thus spacing of electrodes permits electrical measurement beyond the aureole saturated with drilling fluid.

The self-potential curve on the left side of the film (Plates 1, 2) is caused by changes in potential, which are measured as the electrode passes the various strata; and these changes, in turn, are caused by potentials in the strata prior to drilling[8,9] and by potentials resulting from the artificial conditions that exist in and around the boring. Two effects receiving the most attention in articles on electrical logging are the electrofiltration potentials resulting from water movement, both natural and artificial, and the electrochemical potentials resulting from differences in ion concentration of the various strata and the drilling fluid. Where the artifical conditions imposed by drilling are dominant, the self-potential moves to the right (+) if the drilling fluid is more saline than the intraformational water and if the natural artesian pressure on the formation is greater than the hydrostatic pressure in the column of drilling fluid in the well. The movement is to the left (-) if the intraformational water is more saline than the drilling fluid and if the weight of the drilling fluid column is greater than the artesian pressure. The resultant curve is the algebraic sum of these influences,[10] except where the natural potentials dominate, as appears to be the case at Camp Van Dorn.

The simultaneous inspection of the self-potential and resistivity curves shows a separation of indurated rock strata and fresh water

sands, but does not show the differences between fresh water sands and sands containing a non-electrolyte, such as oil or gas. This last distinction is not important here as all the sands are known to be in the fresh water zone.

Mr. R. K. Thies[11] has kindly analyzed the results of the electrical logging at test well 3, Camp Van Dorn, as follows:

"The various fresh-water sands are clearly represented by the high resistivities registered in the ohm-meters on all three curves on the right-hand side of the film. The porosity, or self-potential curve, on the left side is a function both of the porosity of the formation, and of the difference in ion-concentration between the mud and the fluid in the formation. Opposite the sand bodies, at 800 to 885 and 1025 to 1076, this self-potential reads slightly negative (to the left) of what it reads in the tight shaly sections at 420 to 710 and 885 to 1020. In the sand bodies at 1150 to 1250 and 1445 to bottom, the self-potential is more positive (to the right) than it is in the shaly section from 1300 to 1440. This positive "S.P." indicates that these two lower sands contain the higher per cent of fresh water, i.e., either the water is fresher, or more likely, the sand is cleaner and less shaly. This interpretation is substantiated by the driller..... who claimed that in drilling the sand from 800 to 885 the bit "drug", indicating shale, but that in drilling the sand at 1150 to 1250, the bit cut cleanly. Cuttings from this sand showed it to be very clean, though fine-grained.

"The broken character of all curves at 1445 and 1500 indicates this section to be composed of alternate shale and shaly sand beds."

The electrical log thus furnishes a means for comparison of the physical properties of the aquifers encountered by the drill, sharply defines their boundaries, and indicates the more permeable zones within the aquifers. Also, it shows the lower limit of the fresh water sands (Plate 1). Obviously exploration below the fresh water sands in the upper part of the Catahoula sandstone would be valueless as all the lower sands contain saline water.

## PUMPING TESTS

### PROCEDURE

A series of five pumping tests was made of the Camp Van Dorn wells between January 26 and February 10, 1943, by the personnel of the Area Engineer in cooperation with the Post Engineer and under

the direction of the Geological Survey. Of these tests two were made in the six wells drawing from the basal sand of the Homochitto member of the Pascagoula formation; the other three were made in each of the wells drawing from the Fort Adams member of the Pascagoula formation, the basal sand of the Pascagoula formation, and the Catahoula sandstone.

In testing the wells in the Homochitto sand, well 1 was first pumped at a continuous rate of about 560 gallons a minute and the other five wells kept idle until the water levels in the five idle wells were declining equally and at a slight rate. Pumping was then commenced in well 6 at a rate of 580 gallons a minute, without starting or stopping the pumps in the other wells. This increase in pumping from the sand caused additional declines of the water levels in the wells, the rate and amount of the additional decline in each well being inverse in magnitude to the distance from well 6. When, after several days, the water levels in the four remaining idle wells were again declining equally and at a slight rate, pumping from well 1 was stopped. As a result, the water levels in well 1 and the other wells rose, or recovered, the amount and rate of the recovery being inverse to the distance from well 1. The depths to water levels in both the pumped and idle wells were measured to the nearest 0.01 foot at approximately 4-hour intervals throughout the tests by means of a steel tape inserted down the air lines. The pumping rates from wells 1 and 6 were also checked every four hours by the flow meters permanently installed in the discharge lines of the pumps. The discharge remained practically constant during the time the wells were pumped.

Tests of the three wells drawing from the Fort Adams member, from the lower part of the Pascagoula formation, and from the Catahoula sandstone were made by pumping each well for several days and measuring the rate of pumping and depths to pumping level. The wells were then shut down and the rate and amount of recovery of the water levels were measured. Owing to mechanical difficulties, most of the water-level measurements in well 9, drawing from the lower sand in the Pascagoula, were made by an air-pressure gage. These measurements are considered accurate only to the nearest 0.5 foot. Measurements at pumping station 1 in wells 1 (screen set opposite sand of Fort Adams member) and 3 (screen set opposite sand at Catahoula member) were made with a steel tape.

## ANALYSIS

The water-level measurements in the tests were plotted against time as hydrographs which show drawdown and recoveries resulting from various rates of pumping. The hydrographs of the wells in the basal sand of the Homochitto member were analyzed by means of the Thiem equilibrium and the Theis non-equilibrium formula to determine the coefficients of transmissibility and storage. The hydrographs of the single wells in the Fort Adams, the lower Pascagoula, and the Catahoula sands were analyzed only by the Theis non-equilibrium formula to determine the coefficients of transmissibility, since at least two idle observation wells are required in the application of the Thiem formula to determine the transmissibility, and at least one idle observation well is required in the application of the Theis formula in determining the coefficient of storage.

The coefficient of transmissibility indicates the capacity of the water-bearing formation to transmit water to the wells; the coefficient of storage is a measure of the amount of water released from storage in the formation and its confining beds when the artesian head is lowered. Together, they determine the amount and rate of drawdown in water levels by pumping wells.

The coefficient of transmissibility is defined as the number of gallons of water a day that will move through a one-foot wide vertical strip of the height of the aquifer, having a hydraulic gradient of 100 percent. The coefficient of transmissibility is equal to the field coefficient of permeability, expressed in Meinzer's units, multiplied by the thickness of the aquifer.

The coefficient of storage is defined as the volume of water, measured in cubic feet, released from storage in each column of the aquifer having a base one foot square and a height equal to the thickness of the aquifer, when the artesian head is lowered one foot.

A pumping test is made primarily to determine these coefficients from short-term drawdown and recovery curves of water levels in order that the coefficients can be used to determine long-term drawdowns. The purpose of the test, therefore, is essentially to determine the equation of a short water-level drawdown curve and extend the curve over a long period by means of the equation. In applying the equation over the long period, consideration must be given to boundaries of and of changes in the character of the aquifer.

Thiem's formula, for artesian conditions, is

$$T = \frac{527.7q \log_{10} \frac{a_1}{a}}{(s-s_1)}$$

where T is the coefficient of transmissibility; q is the rate of pumping in gallons a minute; a and $a_1$ are the distances in feet of two observation wells from the pumped well; and s and $s_1$ are the respective drawdowns in feet of the water levels in the two observation wells.

The non-equilibrium formula, first developed by Charles V. Theis,[2] of the U. S. Geological Survey, is

$$s = \frac{114.6q}{T} \int_{\frac{1.87r^2S}{Tt}}^{\infty} \frac{e^{-u}}{u} du$$

where s is the drawdown in feet at any point in the vicinity of a well pumped at a uniform rate; q is the discharge of the well in gallons a minute; T is the coefficient of transmissibility of the aquifer; r is the distance in feet from the pumped well to the point of observation; S is the coefficient of storage of the aquifer; and t is the time in days the well has been discharging.

A discussion of these formulas, the assumptions on which they are based, and their application are given in the papers listed in the table of references 1-7. Both formulas assume that the aquifer is infinite in extent, that it is homogeneous and isotropic, that its transmissibility is the same at all places, and that it is bounded by impermeable beds above and below. The non-equilibrium formula further assumes that the coefficient of storage is constant and that the water is released from storage instantaneously with a decline in artesian head. In determining the coefficients, the Thiem formula is applied to the drawdown or recovery of water levels at equilibrium in two observation wells, produced by pumping or shutting down another well. The non-equilibrium formula may be applied in any one of three ways: to the drawdown or recovery of water levels in at least two observation wells at any time; to the amount and rate of drawdown or recovery in a single observation well; or to the rate of recovery in a pumped well after the pump is shut down.

## LABORATORY WORK

The samples were washed by decantation, except those for foraminiferal study and those for heavy mineral separation. Following decantation, permeability was determined by packing the sand in a 14.5 by 3.5 centimeter brass cylinder connected at the base to a glass calibrated manometer tube. The test was made by filling the manometer tube with water, which entered the sand sample at the base and overflowed the rim of the cylinder. By noting the rate of percolation, the ability of the sand to transmit water was approximated.

This method of determining permeability is known as the variable head discharging method.[12] The apparatus used was developed by C. V. Theis, and described by V. C. Fishel and V. T. Stringfield.

A curve drawn from the formula $\dfrac{-47740 \log_{10} \frac{h}{ho}}{\text{time (in seconds)}}$ gives a value in Meinzer's units. The temperature of the water is measured at the time of the test, permitting a viscosity correction to 60° F. The resulting figure as defined by Meinzer[13] is "the rate of flow in gallons a day, through a square foot of its cross section under a hydraulic gradient of 100 percent at a temperature of 60° F." The unit is also defined as "the number of gallons of water a day, at 60° F., that is conducted laterally through each mile of the water-bearing bed under investigation (measured at right angles to the direction of flow), for each foot of thickness of the bed and for each foot per mile of hydraulic gradient." If the temperature of the water is not corrected to 60° F. and if the measurements are made under prevailing conditions, the unit is called "field coefficient of permeability."

The permeability tests of rotary cuttings do not give absolute values for the aquifers; rather, they furnish a comparison of the various sands. More nearly absolute values for determination of safe yield and for prediction of water-level decline can be made by pumping tests which evaluate the aquifer in its natural environment.

Following the permeability tests the samples were dried in an electric oven at a temperature of 150° F.; and 100 grams of the dry material was separated on sieves calibrated in the Wentworth scale.[14]

The results of the mechanical analyses and permeability tests are given in Table 3.

Those samples examined for foraminifera were washed on a 200-mesh qualitative screen and were studied for fossils by mixing a dry sample in carbon tetrachloride and filtering off the floating material. The fraction of the sample for heavy mineral separation was screened and the portion falling between 0.125 and 0.0625 millimeters was mixed with bromoform ($CHBr_3$) of a specific gravity of about 2.72. The minerals heavier than 2.72 sank to the bottom and were drawn off for petrographic study. The light floating fraction of the sands, mostly quartz, various feldspars, calcite, and some of the mica, also was studied under the microscope.

## GEOGRAPHY

### RAINFALL

In this humid climate, the rainfall is rather uniform throughout the year, ranging from an average of 3.10 inches in September to an average of 6.63 inches in July (Table 1).

### DRAINAGE

The camp site is drained by Comite Creek and its tributary, Sharps Creek, which flow southeast and coalesce into Comite River which flows into Amite River east of Baton Rouge. Both streams appear to be permanent, and considerable swampy land along the flanks of the valleys suggests that there is much effluent seepage into the valley floor from the surrounding hills. A few ponds are found along the crests of ridges where natural drainage is poor or where the small streams may be easily impounded. The loessal character and consequent low permeability of the brown loam beneath the upland surface furnish rather impermeable basins for the construction of live-stock watering places.

## TABLE 1

### Precipitation In Woodville, Wilkinson County

### Monthly, Annual, and Average Amounts in Inches

| Year | January | February | March | April | May | June | July | August | September | October | November | December | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1893 | ..... | ..... | 2.05 | 5.60 | 8.03 | 4.37 | 6.21 | 4.50 | 3.70 | 0.91 | 6.07 | 3.19 | ..... |
| 1894 | 7.46 | 7.31 | 7.94 | 2.07 | 1.34 | 5.55 | 6.96 | 5.46 | 5.75 | 0.53 | 1.69 | 3.75 | 55.81 |
| 1895 | 5.52 | 2.86 | 5.01 | 2.94 | 5.53 | 6.37 | 6.43 | 5.24 | 1.41 | 2.10 | 4.12 | 6.46 | 53.99 |
| 1896 | 6.15 | 8.28 | 9.09 | 8.22 | 1.92 | 4.63 | 5.13 | 4.65 | 1.73 | 7.60 | 4.27 | 2.93 | 64.60 |
| 1897 | 7.01 | 3.75 | 4.93 | 3.01 | 4.29 | 5.51 | 6.35 | 9.39 | 1.89 | 2.18 | 4.31 | 6.52 | 59.14 |
| 1898 | 9.03 | 5.49 | 5.71 | 2.23 | 0.95 | 6.58 | 8.62 | 7.62 | 6.18 | 5.05 | 7.01 | 3.22 | 67.69 |
| 1899 | 9.73 | 3.71 | 4.42 | 2.00 | T | 3.31 | 1.94 | 6.46 | 1.10 | 2.04 | 2.60 | 11.39 | 48.70 |
| 1900 | 4.03 | 8.10 | 6.30 | 15.29 | 5.71 | 8.68 | 11.63 | 2.74 | 0.97 | 6.10 | 1.71 | 6.16 | 77.42 |
| 1901 | 4.04 | 5.13 | 5.60 | 5.72 | 0.93 | 1.63 | 10.25 | 5.84 | 4.62 | 0.62 | 3.26 | 9.68 | 57.32 |
| 1902 | 2.63 | 3.45 | 3.84 | 2.59 | 2.49 | 0.47 | 6.00 | 3.54 | 3.80 | 1.51 | 5.25 | 7.90 | 43.47 |
| 1903 | 6.10 | 9.97 | 14.98 | 1.13 | 3.30 | 4.74 | 7.41 | 5.97 | 1.51 | 1.77 | 0.43 | 4.89 | 62.20 |
| 1904 | 3.38 | 2.05 | 3.92 | 1.64 | 2.52 | 3.19 | 7.30 | 6.09 | 3.69 | T | 1.34 | 4.58 | 39.70 |
| 1905 | 6.44 | 10.52 | 4.86 | 9.74 | 7.24 | 7.77 | 10.58 | 4.97 | 8.03 | 4.35 | 7.34 | 4.10 | 85.94 |
| 1906 | 4.05 | 3.39 | 10.18 | 4.03 | 2.44 | 2.59 | 8.15 | 3.39 | 4.09 | 5.72 | 3.52 | 5.21 | 56.76 |
| 1907 | 1.70 | 4.26 | 1.75 | 6.61 | 17.34 | 0.75 | 8.83 | 4.95 | 4.33 | 1.79 | 5.18 | 4.00 | 61.49 |
| 1908 | 5.90 | 5.76 | 4.57 | 7.59 | 8.12 | 5.11 | 7.82 | 8.17 | 3.68 | 0.41 | 2.09 | 3.58 | 62.80 |
| 1909 | 4.67 | 5.12 | 1.79 | 6.97 | 7.67 | 4.05 | 4.55 | 4.15 | 7.69 | 2.29 | 2.02 | 5.18 | 56.15 |
| 1910 | 4.79 | 3.57 | 0.20 | 5.67 | 5.88 | 9.37 | 9.20 | 4.64 | 3.54 | 1.79 | 3.01 | 5.32 | 56.98 |
| 1911 | 2.70 | 1.13 | 1.51 | 5.76 | 1.74 | 5.40 | 13.97 | 6.14 | 3.22 | 1.72 | 5.27 | 12.77 | 61.33 |
| 1912 | 6.36 | 2.88 | 6.25 | 8.39 | 4.81 | 7.40 | 4.39 | 3.67 | 0.70 | 0.93 | 0.86 | 17.40 | 64.04 |
| 1913 | 11.79 | 4.92 | 4.78 | 7.11 | 3.44 | 3.73 | 4.21 | 4.94 | 6.43 | 3.86 | 3.13 | 3.70 | 62.04 |
| 1914 | 1.24 | 3.60 | 7.69 | 6.57 | 2.77 | 2.24 | 4.55 | 10.19 | 1.24 | 0.96 | 6.20 | 7.35 | 54.60 |
| 1915 | 9.65 | 9.00 | 3.12 | 1.94 | 9.16 | 3.10 | 5.37 | 6.34 | 3.08 | 2.29 | 2.00 | 5.27 | 60.32 |
| 1916 | 8.18 | 1.92 | 4.56 | 4.53 | 12.80 | 1.46 | 8.61 | 4.17 | 1.45 | 5.28 | 1.20 | 5.37 | 59.53 |
| 1917 | 7.37 | 6.96 | 3.17 | 6.76 | 0.61 | 2.52 | 3.30 | 6.35 | 1.25 | 1.31 | 1.74 | 3.97 | 45.31 |
| 1918 | 6.37 | 3.78 | 1.48 | 6.57 | 1.21 | 2.55 | 3.19 | 6.58 | 1.86 | 9.78 | 8.33 | 4.16 | 55.86 |
| 1919 | 8.86 | 8.33 | 2.84 | 11.72 | 10.13 | 6.01 | 15.11 | 7.01 | 0.26 | 4.65 | 6.46 | 7.10 | 88.48 |
| 1920 | 5.76 | 3.52 | 4.47 | 3.71 | 2.55 | 4.89 | 5.37 | 10.74 | 3.21 | 1.79 | 4.75 | 13.82 | 64.58 |
| 1921 | 3.75 | 2.76 | 14.16 | 11.43 | 2.45 | 4.55 | 7.03 | 3.57 | 4.29 | 1.42 | 1.23 | 4.13 | 60.77 |
| 1922 | 7.76 | 6.98 | 12.58 | 4.51 | 6.10 | 3.38 | 4.00 | 3.41 | 1.88 | 4.44 | 4.16 | 7.82 | 67.02 |
| 1923 | 3.29 | 6.43 | 7.93 | 9.69 | 8.49 | 11.39 | 5.86 | 7.84 | 2.84 | 1.54 | 5.20 | 9.81 | 80.31 |
| 1924 | 7.90 | 3.75 | 3.48 | 3.88 | 2.67 | 3.96 | 0.46 | 1.08 | 0.13 | 0.25 | 0.55 | 6.67 | 34.78 |
| 1925 | 11.48 | 2.71 | 2.37 | 1.39 | 2.16 | 4.06 | 2.15 | 2.88 | 2.40 | 13.29 | 2.67 | 3.31 | 50.87 |
| 1926 | 7.13 | 3.57 | 15.13 | 6.81 | 4.01 | 3.60 | 0.88 | 10.20 | 2.70 | 7.01 | 5.95 | 9.81 | 76.80 |
| 1927 | 1.33 | 9.93 | 7.08 | 3.34 | 4.07 | 3.83 | 4.29 | 6.19 | 2.59 | 5.23 | 4.99 | 9.06 | 61.93 |
| 1928 | 1.24 | 4.41 | 5.51 | 10.90 | 14.20 | 9.78 | 3.49 | 4.62 | 2.61 | 1.71 | 2.66 | 4.58 | 65.71 |
| 1929 | 7.09 | 10.48 | 8.71 | 3.20 | 7.70 | 2.17 | 11.71 | 1.72 | 3.04 | 9.87 | 14.64 | 3.84 | 84.17 |
| 1930 | 7.40 | 3.26 | 3.60 | 1.67 | 3.06 | T | 4.43 | 2.52 | 6.44 | 2.80 | 6.17 | 4.89 | 46.24 |
| 1931 | 7.38 | 2.88 | 4.19 | 1.48 | 5.37 | 2.26 | 8.03 | 5.75 | 1.29 | 2.61 | 6.68 | 9.08 | 57.00 |
| 1932 | 10.75 | 5.13 | 4.61 | 2.15 | 4.11 | 1.28 | 7.76 | 4.80 | 6.25 | 5.26 | 4.98 | 11.93 | 69.01 |
| 1933 | 5.31 | 6.81 | 5.95 | 7.67 | 5.06 | 1.16 | 8.71 | 5.32 | 1.36 | 2.03 | 0.89 | 3.62 | 53.89 |
| 1934 | 5.21 | 5.49 | 5.96 | 2.25 | 10.80 | 8.91 | 7.14 | 4.91 | 6.67 | 1.80 | 9.57 | 4.04 | 72.75 |
| 1935 | 4.45 | 4.02 | 17.30 | 6.65 | 12.34 | 3.83 | 6.63 | 2.09 | 0.48 | 0.25 | 4.58 | 6.44 | 69.06 |
| 1936 | 3.58 | 6.65 | 2.35 | 5.52 | 3.71 | 0.45 | 9.91 | 5.54 | 2.63 | 1.10 | 4.15 | 8.00 | 53.59 |
| 1937 | 15.62 | 3.87 | 4.22 | 5.78 | 3.40 | 4.17 | 3.70 | 8.91 | 1.75 | 6.36 | 3.03 | 3.05 | 63.86 |
| 1938 | 7.20 | 2.70 | 5.65 | 11.34 | 0.80 | 9.02 | 9.83 | 8.15 | 3.58 | 2.41 | 4.08 | 3.12 | 67.88 |
| 1939 | 7.07 | 8.73 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1940 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1.61 | 5.21 | 9.84 | ..... |
| 1941 | 2.31 | 1.53 | 6.60 | 3.66 | 6.88 | 4.92 | 4.23 | 5.34 | 2.50 | 4.16 | 1.99 | 10.99 | 55.11 |
| 1942 | 5.20 | 3.17 | 7.81 | 4.20 | 2.75 | 4.96 | ..... | ..... | ..... | ..... | 1.23 | ..... | ..... |
| 1943 | ..... | ..... | ..... | ..... | 3.31 | 4.29 | 3.35 | 2.61 | 10.46 | ..... | ..... | ..... | ..... |
| Average | 6.12 | 5.09 | 5.88 | 5.49 | 5.07 | 4.41 | 6.56 | 5.44 | 3.25 | 3.21 | 4.08 | 6.52 | 61.12 |

T = less than 0.01 inch.

Altitude: 560 feet. Data from U. S. Weather Bureau Publications.

### PHYSIOGRAPHY

The camp area is a gently rolling upland within the Long Leaf Pine Hills whose concordant crests form part of an old coastal plain that has been dissected by small streams.

A topographic map prepared by the U. S. Engineers shows a relief of 118.9 feet at the camp site. The highest point is 397.4 feet, the crest of a long southwest-trending ridge south of Centreville; the lowest point is 278.5 feet in the stream bed of Comite Creek at the southeast corner of the map.

Of the two surfaces that stand out, the lower and least apparent is a terrace along the larger streams which decreases from an elevation of about 315 feet in the northern part to 280 feet at the southern edge of the map. This terrace is much more extensive to the south in Louisiana where various authors[15] have referred to it as the St. Elmo terrace, the Lissie Plain, and the "second terrace." Former opinion assigned an early Pleistocene age to its development. At Camp Van Dorn it is formed on clay that is probably of Miocene age, and its position closely corresponds to the position of the base of the Citronelle formation. This relationship suggests that here the surface may be an exhumed part of the peneplain upon which the Citronelle formation was deposited. The other dominant topographic feature at Camp Van Dorn is the gently rolling upland whereon most of the camp is built. The least eroded remnants of this surface slope to the south about 12 feet per mile, but the present drainage has increased the gradient of all slopes toward the small tributary streams. This surface may be the equivalent of the Williana terrace as described by Fisk[16] or the surface on the top of the Willis formation as described by Doering.[17]

## GEOLOGY AND GROUND-WATER HYDROLOGY

### SUMMARY OF STRATIGRAPHY

The deposits yielding fresh water beneath the camp are Tertiary and Quaternary sediments that range in age from Miocene to Pliocene or possibly to early Pleistocene. The deepest and correspondingly the oldest formation likely to yield fresh water is the Catahoula sandstone of Miocene age. Only the upper 253 feet of sands and shale of the Catahoula formation were explored (a depth interval of 1,443-1,696 feet beneath the surface at test well 3), because the lower

part is known to contain little sand and the water to be brackish or salty.

The Hattiesburg formation of Miocene age immediately overlies the Catahoula sandstone. In test well 3 this formation is considered to be 560 feet thick (depth interval 883-1,443 feet beneath the surface) and is composed of clay, shale, and fine-grained sand. Overlying the Hattiesburg formation is the Pascagoula formation which is also of Miocene age and considered to be 804 feet thick at test well 3 and 742 feet thick at pumping station 9. The Pascagoula formation crops out on the lower flanks of the valleys or is covered with only a thin surficial blanket of debris, but beneath the hills it is buried by as much as 100 feet of sand, sandy gravel, and clay of the Citronelle formation. Oil geologists recognize two stratigraphic units in the upper Miocene of this region;[18] namely, an upper Fort Adams member and a lower "Knoxville" member. The name "Knoxville" is preoccupied, and therefore, the name Homochitto member is here proposed. The Fort Adams and Homochitto members are provisionally assigned to the Pascagoula formation. The basal sands of each of these members are water-bearing sands, that of the Homochitto member being the most important aquifer at the camp. The Citronelle formation has been considered of Pliocene age by most authors, but some of the deposits formerly included in the Citronelle may be of younger Pleistocene age.

Although a careful search was made, no fossils were found in the cuttings except a few unidentified megascopic fragments from a depth of 509 feet in test well 3, probably from the lower part of the Pascagoula formation. Therefore, the stratigraphic units here defined are based on correlations with outcrops to the northwest and on the lithology and mineralogy of the samples. Where a choice of correlations could be made within the well field, the most logical structural pattern was used.

GEOLOGIC FORMATIONS CONTAINING FRESH WATER BENEATH CAMP VAN DORN

| | Formation | Member | Thick | Physical Character (Based on Test Well 3) | Hydrologic Properties |
|---|---|---|---|---|---|
| Pliocene or Pleistocene | Citronelle | | 0-95 | Sand, gravel, mostly brown chert and quartz, and clay; highly cross-bedded and irregularly stratified, locally indurated to conglomerate or sandstone. | Only the lower few feet yield water perennially as streams have cut through the base and lowered the water table. |
| Miocene | Pascagoula | Fort Adams | 135-235 | Fine sand and light-gray or green clay — heterogeneous and oxidized in part. | Furnishes water containing considerable iron and free carbon dioxide to a well at Camp Van Dorn and at Centreville. |
| | | Homochitto | 181-252 | Sand, blue-green clay, and silt. Very coarse sand or fine gravel at the base. | Basal sand yields water copiously and furnishes supply to six wells at the camp and one well at Centreville but requires treatment because of dissolved iron and free carbon dioxide. |
| | | Lower portion | 362-466 | Shale, sandy shale, siltstone, and fine to medium sand, coarser at the base. Some of the shale is calcareous. Glauconite and siderite are present and probably brackish water mollusca. | The basal sand yields water low in iron and free carbon dioxide to one well and probably is capable of producing large supplies. The depth and low water level make higher sands more favorable. |
| | Hattiesburg | | 560 | Interbedded fine angular sand, gray and gray-green shale, and gray sandy shale. Some of the shale and sandy shale is calcareous. Siderite is abundant. | Although the interbedded fine sands are unusually uniformly grained, the grain size would make development difficult. |
| | Catahoula | | 253 | Sand, fine to coarse, and shale; non-marine where explored. | Yields abundant water to one well under a hydrostatic head lower than overlying sands and contains iron and free carbon dioxide in sufficient amount to require treatment. |

## MIOCENE

### CATAHOULA SANDSTONE

#### GENERAL GEOLOGY

The Catahoula sandstone crops out in a belt 30 miles wide, the nearest point to Camp Van Dorn being about 60 miles north. The outcrop area extends across Mississippi in a west-northwest direction; the beds dip south into the Gulf Coast geosyncline. At the camp the subsurface thickness is probably several hundred feet, but the lower part contains less sand. The presence of marine fossils in tongues of marine sediments suggests that the occluded water is salty or at least brackish. The electrical logs of oil prospect wells substantiate this conclusion (Plate 1).

The upper 253-foot interval of the Catahoula sandstone at test well 3 is composed of angular quartz sand, light-gray shale, and light-gray clayey siltstone. Although these sand grains are much more angular than sands encountered at shallower depths, almost all are frosted, suggesting an eolian origin. Indeed the sand samples from a depth interval 1,612-1,656 feet show a grain size distribution suggesting an eolian origin whereas the samples from 1,656 to 1,699 feet show a grain size distribution suggestive of deposition by currents in water (Table 3).

Of the samples treated with bromoform for separation of heavy minerals, the fractions whose specific gravities are less than 2.72 contain as much as 15 or 20 percent orthoclase feldspar and a few grains of sodic plagioclase. There is almost no microcline in comparison to the abundant microcline in the sands of the overlying Hattiesburg and Pascagoula formations (Table 2). Some brown chert in the coarser fractions of the Catahoula samples may be from the Citronelle or Pascagoula beds, or may be indigenous. The heavier minerals show some zoning in their vertical distribution, notably an increase toward the base of pyrite, magnetite, (and other black opaque grains) almandite garnet, staurolite, tourmaline, kyanite, and zircon (Table 2). All these minerals are abundant in overlying beds and therefore cannot be considered diagnostic; nevertheless, the similar suites suggest that the grains in all four formations probably came from the same general region. Siderite ($FeCO_3$), a mineral which is abundant in the overlying beds, is nearly absent from the Catahoula sandstone; the few spherules of this mineral ob-

TABLE 2.

HEAVY MINERAL DISTRIBUTION IN TEST HOLE 3, CAMP VAN DORN

| Minerals | Citronelle | Pascagoula formation: Fort Adams member | | | | | | Pascagoula formation: Homochitto member | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | 68-77 | 89-102 | 102-134 | 134-156 | 156-179 | 179-200 | 200-224 | 224-227 | 227-245 | 245-290 | 290-334 | 334-378 | 378-400 | 400-424 |
| Opaque | | | | | | | | | | | | | | |
| Magnetite, Ilmenite, Leucoxene, Hematite | cc | cc | cc | cc | cc | cc | cc | cc | cc | cc | cc | cc | cc | cc |
| Pyrite | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Spherulitic marcasite | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Siderite (some translucent) | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Transparent and translucent | | | | | | | | | | | | | | |
| Zircon | | | | | | | | | | | | | | |
| Clear crystals | c | c | c | B | c | c | B | c | c | c | c | c | B | c |
| Frosted and fragmental | c | c | c | c | c | c | c | c | c | c | B | c | c | c |
| Pale salmon and pink (many inclusions) | B | B | c | B | B | B | B | c | B | B | B | c | B | B |
| Nearly opaque | c | B | B | B | B | — | — | B | — | B | B | B | B | B |
| Kyanite fragments | | | | | | | | | | | | | | |
| Clear | c | c | c | c | c | B | B | c | B | c | c | B | B | B |
| Blue | c | — | — | — | — | — | — | — | — | — | — | B | — | B |
| Staurolite (fragmental) | c | c | c | B | c | B | B | B | B | c | B | B | B | B |
| Tourmaline, brown crystals, fragments and rounded grains, one blue crystal | c | B | B | c | c | c | B | — | B | B | c[2] | c | c | B |
| Rutile (fragments and crystals) | c | B | B | B | B | B | B | B | B | B | B | c[2] | B | c |
| Epidote (fragments) | B | B | B | — | B | B | B | B | B | B | B | B | B | B |
| Uvarovite (?), bright green | — | — | — | B | — | — | — | B | B | B | B | — | — | — |
| Muscovite | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Biotite | — | — | — | c | — | B | — | — | — | B | — | — | — | — |
| Almandite garnet (light pink fragments) | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Green hornblende | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Spinel (?), bright blue | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| Minerals | Pascagoula formation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | 424-466 | 466-509 | 509-532 | 532-554 | -665 | 665-685 | 685-729 | 729-771 | 771-813 | 813-856 | 856-899 |
| Magnetite, Ilmenite, Leucoxene, Hematite | cc | — | Insufficient grains | c | cc | c | c[1] | c | c | c | c |
| Pyrite | — | — | | — | B | c | — | c | c | c | cc |
| Spherulitic marcasite | — | — | | — | — | c | — | c | c | c | c |
| Siderite (some translucent) | — | — | | — | — | — | — | — | — | B | B |
| Zircon: Clear crystals | B | B | | B | c | c | c | c | c | c | B |
| Zircon: Frosted and fragmental | c | c | | B | c | c | c | c | c | c | c |
| Zircon: Pale salmon and pink (many inclusions) | — | B | | — | B | c | B | c | B | B | c |
| Zircon: Nearly opaque | — | c | | — | B | — | — | B | B | B | B |
| Kyanite fragments: Clear | B | c | | c | cc | c | — | c | c | c | c |
| Kyanite fragments: Blue | — | — | | — | — | B | — | B | B | B | — |
| Staurolite (fragmental) | B | — | | — | c | B | — | B | B | B | B |
| Tourmaline, brown crystals, fragments and rounded grains, one blue crystal | B | B | | B | B | c | c | c | c | c | c |
| Rutile (fragments and crystals) | B | B | | B | B | B | B | B | B | B | — |
| Epidote (fragments) | B | B | | B | c | B | c[2] | — | cc | cc | c |
| Uvarovite (?), bright green | — | — | | — | B | B | B | B | B | — | — |
| Muscovite | — | — | | — | — | c | c | c | c | c | — |
| Biotite | — | — | | — | — | B | B | B | B | B | B |
| Almandite garnet (light pink fragments) | — | — | | — | — | — | B | B | c | c | c |
| Green hornblende | — | — | | — | — | — | c | c | c | c | B |
| Spinel (?), bright blue | — | — | | — | — | — | — | B | — | — | — |

| Minerals | Hattiesburg formation | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | 899-942 | 942-986 | 986-1029 | 1029-1051 | 1051-1073 | 1079-1160 | 1160-1182 | 1182-1202 | 1202-1225 | 1225-1246 | 1246-1258 | 1258-1288 | 1288-1307 | 1307-1322 | 1334-1377 | 1377-1399 | 1399-1421 | 1421-1443 |
| Magnetite, Ilmenite, Leucoxene, Hematite | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c |
| Pyrite | c | c | — | c | B | B | c | cc | cc | cc | cc | B | c | B | c | c | c | c |
| Spherulitic marcasite | c | c | — | — | B | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Siderite (some translucent) | c | cc | cc | c | B | c | c | c | c | c | c | cc | cc | cc | cc | cc | cc | cc |
| Zircon: Clear crystals | c | B | c | c | c | B | B | B | B | c | c | B | B | B | — | — | B | B |
| Zircon: Frosted and fragmental | c | c | c | c | c | c | c | c | c | c | c | B | c | B | — | — | c | c |
| Zircon: Pale salmon and pink (many inclusions) | c | B | B | c | c | B | B | B | B | B | B | — | B | — | — | — | — | — |
| Zircon: Nearly opaque | — | — | — | B | B | B | — | — | — | B | B | c | B | — | — | — | — | — |
| Kyanite fragments: Clear | B | B | — | B | c | c | c | c | c | c | c | c | c | c | B | B | B | B |
| Kyanite fragments: Blue | — | — | — | B | — | — | — | — | — | — | — | B | — | — | — | — | — | — |
| Staurolite (fragmental) | B | B | B | — | c | c | B | B | B | B | B | B | B | — | B | — | B | B |
| Tourmaline, brown crystals, fragments and rounded grains, one blue crystal | B | c | B | c | c | c | B | c | c | c | B | B | B | B | B | B | B | c |
| Rutile (fragments and crystals) | B | B | B | B | — | — | — | — | B | — | — | B | — | — | — | — | — | B |
| Epidote (fragments) | — | B | — | — | — | B | c | B | B | c | B | B | B | B | — | — | — | — |
| Uvarovite (?), bright green | — | — | — | B | B | B | B | — | B | — | — | — | — | — | — | — | — | — |
| Muscovite | — | — | B | B | B | c | — | B | c | c | — | B | B | c | B | c | — | B |
| Biotite | B | — | — | — | — | B | — | — | — | — | — | — | B | — | — | B | — | — |
| Almandite garnet (light pink fragments) | c | B | B | — | B | B | B | — | B | B | B | B | — | — | — | — | — | — |
| Green hornblende | B | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Spinel (?), bright blue | — | — | — | B | B | — | — | — | B | B | — | — | — | — | — | — | — | — |

| Minerals | Catahoula sandstone | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | 1443-1465 | 1465-1487 | 1487-1509 | 1509-1552 | 1552-1573 | 1573-1595 | 1595-1635 | 1635-1656 | 1656-1676 | 1676-1699 |
| Magnetite, Ilmenite, Leucoxene, Hematite | — | c | cc | c | cc | c | c | c | c | c |
| Pyrite | c | c | c | cc | cc | cc | cc | cc | cc | cc |
| Spherulitic marcasite | c | B | B | B | B | — | — | — | — | — |
| Siderite (some translucent) | c | c | c | B | B | B | B | B | B | B |
| Zircon: Clear crystals | c | B | — | B | B | B | B | B | B | B |
| Zircon: Frosted and fragmental | c | c | — | c | c | c | c | c | c | c |
| Zircon: Pale salmon and pink (many inclusions) | B | — | — | — | B | — | B | B | B | B |
| Zircon: Nearly opaque | B | — | — | — | B | B | B | B | B | B |
| Kyanite fragments: Clear | B | c | c | c | — | c | c | c | c | c |
| Kyanite fragments: Blue | — | B | B | — | — | B | B | B | B | B |
| Staurolite (fragmental) | B | B | cc | cc | c | B | c | c | c | c |
| Tourmaline, brown crystals, fragments and rounded grains, one blue crystal | c | c | c | c | B | — | B | B | c | c |
| Rutile (fragments and crystals) | — | — | — | — | — | — | — | — | B | B |
| Epidote (fragments) | B | B | B | B | c | B | B | B | B | B |
| Uvarovite (?), bright green | — | — | — | — | — | — | — | — | B | — |
| Muscovite | B | B | B | B | B | B | c | c | B | B |
| Biotite | B | — | B | — | — | — | B | B | — | — |
| Almandite garnet (light pink fragments) | B | B | c[2] | c | c | c | c | c | B | B |
| Green hornblende | — | — | — | — | — | — | — | — | — | — |
| Spinel (?), bright blue | — | — | B | B | — | — | — | — | — | — |

[1] Marked decrease; [2] Marked increase; B Only one or two grains; c Fairly abundant; cc Abundant.

served probably are contamination. Marcasite seems to define the upper boundary of a pyrite zone in the Catahoula sandstone, a relationship that parallels a similar zoning of these sulphides in shallower beds.

The frosted grains, size distribution, and absence of minerals associated with marine sediments suggest that the upper Catahoula sandstone was deposited in a non-marine environment which produced heterogeneous deposits. This inference as to origin is important from the hydrologic viewpoint in that other wells to the Catahoula sandstone may not penetrate beds of a similar permeability at depths comparable to that of well 3. This conclusion is further strengthened by inspection of the logs of oil prospect wells.

### HYDROLOGY OF THE CATAHOULA SANDSTONE

To determine the water-bearing capacity of the Catahoula sandstone, the screen in the well completed in the deep test hole at pumping station 1 was set opposite the upper Catahoula sand. Although the original static water level was 238 feet below the land surface, tests showed the sand to be highly productive. The permeability of the sand as measured on cuttings in the laboratory and given in Meinzer's units ranges from 313 to 1,827 in four samples and averages 978 (Table 3). A pumping test was made of the well between February 5 and February 9. After 3 days of continuous pumping at a rate of about 940 gallons a minute, the water level was 282 feet below the pump base. It rose 34 feet in the first 2 hours after the pump was shut down, and only about 0.2 foot more in the next 22 hours. The specific capacity of the well for 2 hours of pumping, therefore, is about the same as for 1 day and is 27.9 gallons a minute per foot of drawdown. Theis' non-equilibrium formula was used to analyze the rate of recovery and gave a coefficient of transmissibility of 440,000 for the first 1 1/2 hours of the recovery and 1,032,000 for the next 14 hours. These figures indicate that the Catahoula sandstone is capable of yielding large quantities of water to wells with small drawdowns—and that wells with specific capacities higher than 27.9 can probably be developed in the formation.

The electrical log also furnishes some information about the quality and quantity of water in the Catahoula sandstone. The self-potential or permeability curve shifted about 27 millivolts to the right (+) opposite the Catahoula sandstone, seemingly characteristic of

the deeper fresh water sands in Wilkinson and Amite Counties. Such a large shift suggests high permeability, but it will be remembered that the self-potential curve is a resultant of at least two factors, electrofiltration and electrochemical action, either one of which can be natural pre-boring potential or potential resulting from the artificial environment around and in the boring. The electrofiltration effect, both natural and artificial, is closely related to permeability, here the primary concern.

Wells are developed in three other sands, so that it is possible to evaluate the influence of the differential pressure on the shift of the self-potential curve developed by drilling.

| Self-potential (millivolts) | Difference in pressure between mud column in well and hydrostatic pressure on sand (Pounds per square inch in favor of the mud column). | Water-bearing bed |
|---|---|---|
| 0 | 22.5 | Fort Adams |
| -8 | 92 | Homochitto |
| -5 | 118 | Pascagoula |
| +27 | 253 | Catahoula |

This evaluation shows clearly that here the self-potential shift and reversal are not primarily caused by the artificial filtration effect, and therefore must be due to geochemical conditions, natural filtration, or some other cause.

The natural mud in the hole at the time of the electrical test was largely derived from marine or brackish water clays and shale, plus some lime added by the driller. The Catahoula water is from a nonmarine environment, seemingly imposing a condition tending to increase the electrochemical effect, but a similar shift in overlying marine Hattiesburg sand implies that such is not the case.

Indeed all the interstitial waters contain less than 165 parts per million of total dissolved solids and the chlorides range only from 3.4 to 8 parts per million (Table 8). It appears necessary then to explain the self-potential reversal between 900 and 1,000 feet by settling of the lime into the lower part of the hole (which seems unlikely), or by a natural potential existing in the earth strata, possibly as a result of ground-water movement prior to well construction, or

by some unknown factor. A similar reversal is shown on the electrical log of the Kirby Petroleum Corporation Lanehart No. 1 test well (SE. 1/4, SE. 1/4, Sec. 22, T. 1 N., R. 2 W.) within a depth interval of 840-940 feet (Plate 1). This well is 15 miles west of the camp and has the only electrical log which extends high enough stratigraphically to show the shift. The coefficients of transmissibility of the basal Pascagoula and the Catahoula sandstone are high so that the senior author is inclined to believe that the large self-potential shift found opposite these and the Hattiesburg sands is due to natural electrofiltration potential resulting from ground-water movement.

The maximum lateral resistance in test well 3 in the Catahoula sandstone is 500 ohms per cubic meter, compared to a maximum lateral resistance of 700 ohms for the basal sand of the Homochitto member of the Pascagoula formation. This lower resistance implies that the water in the Catahoula sandstone contains more dissolved salts than the water in the basal sand of the Homochitto member and therefore offers less resistance to the electrical current. This conclusion is substantiated by the chemical analyses of the waters.

More accessible shallower supplies make it unnecessary to drill additional wells into the Catahoula sandstone, whose contained water may be considered largely as a potential reserve.

## TABLE 3

### Mechanical Analyses and Coefficients of Permeability, Camp Van Dorn

| Fort Adams member of Pascagoula formation. Pumping Station 1. Well 3<br>Depth (feet) | 4mm. gravel | 2mm. fine gravel | 1mm. grit | 0.5mm. coarse sand | 0.25mm. medium sand | 0.125mm. fine sand | 0.062mm. very fine sand | 0.00mm. silt, etc. | Total residue | Laboratory coefficient of permeability** |
|---|---|---|---|---|---|---|---|---|---|---|
| 102-134 | 0.32 | 1.70 | 1.59 | 3.46 | 35.45 | 53.56 | 3.33 | 0.72 | 100.13 | 397 |
| 134-156 | 0.00 | 0.79 | 0.84 | 2.05 | 40.80 | 52.60 | 2.70 | 0.37 | 100.15 | 536 |
| 156-179 | 0.00 | 0.29 | 0.66 | 1.97 | 27.94 | 60.05 | 7.80 | 1.30 | 100.01 | 278 |
| 179-200 | 0.42 | 1.95 | 1.52 | 4.24 | 55.87 | 34.31 | 1.21 | 0.52 | 100.04 | 814 |
| 200-224 | 0.00 | 0.28 | 1.90 | 9.25 | 62.71 | 25.39 | 0.46 | 0.11 | 100.10 | 814 |
| Pumping Station 2 | | | | | | | | | | |
| 224-227 | 0.00 | 5.93 | 7.70 | 19.33 | 41.00 | 25.52 | 0.52 | 0.01 | 100.01 | 960 |
| Pumping Station 4 | | | | | | | | | | |
| -240 | 0.00 | 0.38 | 0.66 | 4.00 | 42.85 | 46.01 | 5.65 | 0.29 | 99.84 | 595 |
| Pumping Station 6 | | | | | | | | | | |
| 130-280 | 0.00 | 0.50 | 3.14 | 18.10 | 56.47 | 20.25 | 1.34 | 0.25 | 100.05 | 705 |
| Homochitto member of Pascagoula formation. Pumping Station 1. Well 3 | | | | | | | | | | |
| 335-378 | 0.00 | 0.00 | 0.06 | 1.43 | 68.35 | 28.68 | 0.98 | 0.35 | 99.85 | 760 |
| 378-400 | 0.00 | 0.10 | 2.41 | 14.88 | 71.43 | 10.64 | 0.27 | 0.12 | 99.85 | 1102 |
| 400-422 | 0.00 | 0.00 | 2.00 | 14.87 | 69.41 | 13.27 | 0.26 | 0.09 | 99.90 | 1102 |
| 422-424 | 0.00 | 3.71* | 49.38 | 16.90 | 27.66 | 1.99 | 0.10 | 0.26 | 100.00 | ..... |
| Pumping Station 2 | | | | | | | | | | |
| 324-345 | 0.00 | 0.19 | 0.64 | 6.13 | 79.52 | 13.31 | 0.13 | 0.00 | 99.92 | 1162 |
| 345-367 | 0.00 | 0.00 | 0.50 | 6.85 | 74.84 | 17.74 | 0.07 | 0.03 | 100.03 | 1224 |
| 367-389 | 0.00 | 0.00 | 1.37 | 12.55 | 69.12 | 16.56 | 0.25 | 0.01 | 99.86 | 1164 |
| 389-408 | 0.00 | 0.45 | 1.91 | 14.43 | 64.80 | 18.03 | 0.25 | 0.20 | 100.07 | 970 |
| Pumping Station 4 | | | | | | | | | | |
| -380 | 0.00 | 0.58 | 2.57 | 11.00 | 54.95 | 28.83 | 1.89 | 0.18 | 100.00 | 699 |
| 380-405 | 0.00 | 0.61 | 1.06 | 6.75 | 68.12 | 22.02 | 1.28 | 0.01 | 99.85 | 854 |
| 405-430 | 0.00 | 5.05 | 6.77 | 18.32 | 54.41 | 14.15 | 1.17 | 0.12 | 99.99 | 864 |
| Pumping Station 6 | | | | | | | | | | |
| 398-420 | 0.00 | 0.00 | 0.35 | 1.55 | 68.15 | 27.81 | 1.91 | 0.25 | 100.02 | 845 |
| 420-441 | 0.00 | 0.29 | 0.51 | 2.97 | 79.08 | 16.33 | 0.76 | 0.08 | 100.02 | 1042 |
| 441-462 | 0.00 | 0.27 | 3.57 | 23.41 | 64.15 | 8.18 | 0.27 | 0.05 | 99.90 | 1169 |
| 462-476 | 0.00 | 0.72 | 5.80 | 19.99 | 61.55 | 11.30 | 0.45 | 0.20 | 100.01 | 1079 |

(TABLE 3—Continued)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pumping Station 7 | | | | | | | | | | |
| -388 | 0.00 | 0.00 | 0.50 | 2.93 | 58.16 | 37.31 | 0.69 | 0.14 | 99.73 | 744 |
| 388-409 | 0.00 | 0.00 | 4.18 | 22.47 | 59.70 | 13.62 | 0.11 | 0.10 | 100.18 | 916 |
| 409-431 | 0.00 | 0.00 | 4.00 | 21.47 | 64.14 | 10.10 | 0.13 | 0.04 | 99.88 | 1350 |
| 431-453 | 0.00 | 0.00 | 3.33 | 16.35 | 68.61 | 11.27 | 0.28 | 0.03 | 99.87 | 1046 |
| 453-476 | 0.00 | 0.00 | 1.18 | 6.88 | 65.11 | 26.48 | 0.14 | 0.03 | 99.82 | 841 |
| Pumping Station 10 | | | | | | | | | | |
| 369-390 | 0.00 | 0.30 | 2.45 | 14.10 | 72.49 | 10.55 | 0.09 | 0.00 | 99.98 | 1152 |
| 390-413 | 0.00 | 0.61 | 2.33 | 13.20 | 70.72 | 12.79 | 0.16 | 0.06 | 99.87 | 976 |
| 413-435 | 0.00 | 0.13 | 4.61 | 28.37 | 61.70 | 4.92 | 0.24 | 0.05 | 100.02 | 1190 |
| Basal part of Pascagoula formation. Pumping Station 1. Well 3 | | | | | | | | | | |
| 813-856 | 0.00 | 0.00 | 0.87* | 1.55* | 20.33* | 72.02 | 3.30 | 1.82 | 99.89 | 228 |
| 856-899 | 0.00 | 0.00 | 0.80* | 15.81* | 68.77* | 12.77 | 1.13 | 0.67 | 99.95 | 675 |
| Pumping Station 9 | | | | | | | | | | |
| Sample 1 | | | | | | | | | | |
| 790-815 | 0.00 | 0.06 | 0.29 | 4.00 | 47.55 | 45.71 | 1.65 | 0.65 | 99.91 | 465 |
| 815-835 | 0.00 | 0.10 | 0.10 | 11.13 | 76.29 | 11.03 | 0.76 | 0.47 | 99.88 | 744 |
| Sample 2 | | | | | | | | | | |
| 779-795 | 0.00 | 0.00 | 0.00 | 0.29 | 18.60 | 68.00 | 11.36 | 1.45 | 99.70 | 326 |
| 795-816 | 0.00 | 0.00 | 0.61 | 2.68* | 28.00* | 62.48 | 5.37 | 0.42 | 99.56 | 380 |
| 816-840 | 0.00 | 0.00 | 0.46* | 5.48 | 49.53 | 43.00 | 1.33 | 0.17 | 99.97 | 548 |
| Hattiesburg formation. Pumping Station 1. Well 3 | | | | | | | | | | |
| 1051-1073 | 0.00 | 0.00 | 0.00 | 0.00 | 9.52 | 82.86 | 7.55 | 0.12 | 100.05 | 339 |
| 1073-1079 | 0.00 | 0.00 | 0.00 | 0.20* | 19.00 | 75.49 | 4.19 | 1.05 | 99.93 | 306 |
| 1160-1182 | 0.00 | 0.00 | 0.00 | 0.58* | 7.83 | 61.45 | 23.44 | 6.62 | 99.92 | 262 |
| 1182-1202 | 0.00 | 0.00 | 0.00 | 0.00 | 2.55 | 82.61 | 13.99 | 0.88 | 100.03 | 455 |
| 1202-1225 | 0.00 | 0.00 | 0.00 | 0.00 | 4.03 | 78.21 | 16.12 | 1.57 | 99.93 | 320 |
| 1225-1246 | 0.00 | 0.00 | 0.00 | 0.00 | 18.75 | 78.12 | 2.98 | 0.25 | 100.10 | 476 |
| 1246-1257 | 0.00 | 0.00 | 0.00 | 0.00 | 24.65 | 67.54 | 5.43 | 2.29 | 99.91 | 446 |
| Catahoula sandstone. Pumping Station 1. Well 3 | | | | | | | | | | |
| 1612-1635 | 0.00 | 0.00 | 0.00 | 0.95 | 45.22 | 50.18 | 1.97 | 1.64 | 99.96 | 313 |
| 1635-1656 | 0.00 | 0.22 | 21.41 | 61.81 | 14.19 | 1.79 | 0.30 | 0.33 | 100.05 | 1827 |
| 1656-1676 | 0.00 | 0.00 | 1.08 | 21.51 | 50.84 | 25.22 | 0.79 | 0.59 | 100.03 | 740 |
| 1676-1699 | 0.00 | 0.00 | 0.32 | 9.08 | 75.11 | 14.45 | 0.62 | 0.47 | 100.05 | 1033 |

* Minor shale, clay, or silt contamination in this fraction.
** Meinzer's units.

### HATTIESBURG FORMATION

The Hattiesburg formation is exposed at the surface in an area that extends across Mississippi in a belt 15 to 30 miles wide parallel to the exposures of the Catahoula sandstone. Down the dip, that is, to the south, the Hattiesburg formation overlies the Catahoula sandstone and dips beneath the Pascagoula formation. A reconnaissance geologic map of the state published in 1928 shows the Hattiesburg formation as near to the camp as 33 miles, but some recent investigators have experienced difficulty in distinguishing the Hattiesburg formation from the overlying Pascagoula formation. This distance therefore may be open to question. At Camp Van Dorn the Hattiesburg formation is considered, by the senior author, to be the stratigraphic unit found in test well 3 within the depth interval 885-1,445 feet, a thickness of 560 feet. This interval is composed of shale, sandy shale, and fine quartz sand. The shale and sandy shale are waxy brown and green, in some places calcareous, and contain numerous spherules of siderite. The other abundant heavy mineral is pyrite. Although other common heavy minerals are present, they are not as abundant, especially in the lower part of the formation, as in the Catahoula sandstone or the Pascagoula formation (Table 2). Quartz is by far the most common mineral, but orthoclase, sodic plagioclase, and microcline are abundant in the lighter fractions of the fine sands. A striking characteristic of the sands is their high degree of sorting—more than 60 percent of all the sand grains are held by the 0.125 mm. screen.

The small grain size of the Hattiesburg sand beds makes development of a water supply difficult with present well drilling methods, and, accordingly, no water is produced from this formation at Camp Van Dorn. The grain size and coefficients of permeability of samples from the Hattiesburg formation are given in Table 3.

### PASCAGOULA FORMATION, GENERAL

The Pascagoula formation is exposed in a large area in south Mississippi along the stream beds and the lower valley flanks. Most of the surface in its area of outcrop, as at Camp Van Dorn, is covered with remnants of the Citronelle formation and younger terrace deposits.

A thickness of 804 feet at test well 3 and 742 feet at pumping station 9 is tentatively assigned to the Pascagoula formation.

Two sedimentary units of the upper Miocene have been recognized and mapped in Wilkinson and Franklin Counties. The Mississippi Geological Society has published a description of them under the names Fort Adams member, from a type locality along the road at the bluffs above Fort Adams in western Wilkinson County, and a lower member the "Knoxville" from the small town of that name in southwestern Franklin County.[19] The name Knoxville is preoccupied and, accordingly, the name "Homochitto" member is here proposed and later described for the beds defined by the Mississippi Geological Society in their Jackson to Recent Field Trip Guidebook, February 10 and 11, 1940. The stratigraphic position of these two members in the Miocene section in Mississippi is not definite. Inasmuch as the location of the Pascagoula-Hattiesburg contact[20] is northwest, and, therefore, stratigraphically lower than either the Fort Adams or the Homochitto members, these members are considered here as belonging to the Pascagoula formation. Certainly they are high in the Miocene section at the camp, if not actually younger than the Miocene.

## PASCAGOULA FORMATION, SEDIMENTS IN THE LOWER PART

### GENERAL GEOLOGY

Sediments in the depth interval 419-883 feet at test well 3 are shale, sandy shale, siltstone, and sand. Below a depth of 466 feet much of the shale is calcareous, and siderite is present in the basal sand. Also a few grains of glauconite, usually a marine sedimentary mineral, are scattered throughout the interval, and a few fragments of fossil mollusca were found at a depth of 509 feet. The basal sand is medium-grained (0.25-0.50 mm. diameters) in test well 3, pumping station 1, and fine-grained to medium-grained (0.125-0.50 mm. diameters) at pumping station 9 (Table 3). This sand contains abundant epidote, green hornblende, and almandite garnet among the transparent heavy minerals. Of the opaque minerals pyrite is more abundant than the black opaque minerals. The feldspars, orthoclase and microcline, are present but not abundant at pumping station 9; they are fairly abundant at test well 3, pumping station 1.

These beds are here referred to the Pascagoula formation rather than to the underlying Hattiesburg, because the most pronounced change in mineral content is at a depth of 883 feet and because the grain size of the sand at the base of the interval is much larger than the grain size of the sands of the Hattiesburg.

### HYDROLOGY OF THE SAND IN THE LOWER PART OF THE PASCAGOULA FORMATION

The mechanical analyses and coefficients of permeability of rotary cuttings of the basal sand of the Pascagoula indicate that this is the only sand favorable to development in the lower part of the Pascagoula formation, and one well, at pumping station 9, produces from it (Table 3). The original static level of water in this well was 224.9 feet beneath the surface of the land and 158.33 feet above mean sea level, or 40 feet higher than the static level in well 3, pumping station 1, which is developed in the Catahoula sandstone.

In a pumping test of well 9 (February 2 to February 7, 1943) the water level after 4 days of continuous pumping at an average rate of about 390 gallons a minute was 263 feet below the pump base. It recovered 36.5 feet in the first 12 hours after the well was shut down, and during the next 12 hours the recovery was very slight. Such a recovery gives a 1-day specific capacity of 10.7 gallons a minute per foot of drawdown. It was possible to make only air-line measurements and the rate of recovery was only roughly determined. However, the non-equilibrium formula was used to analyze the results and gave a coefficient of transmissibility of 99,000. A rough analysis of the contractor's original test gave 76,000. Both of these figures are higher than any determined for the sand in the Homochitto member. They indicate that wells of somewhat larger specific capacities than 10.7 can probably be developed in the basal sand of the Pascagoula, and also that the sand is capable of supplying large quantities of water to wells—probably more than the sand in the Homochitto can supply with comparable drawdowns.

The depth to water in well 9, originally about 65 feet greater than the depth to water in the Homochitto wells, should be considered in determining whether more water should be withdrawn from the basal Pascagoula than well 9 will now supply. Relative amount of withdrawals from the sands should be based on the relative costs of pumping, which in turn depend on the depths to pumping levels.

## PASCAGOULA FORMATION, HOMOCHITTO MEMBER

### GENERAL GEOLOGY

This unit crops out in a narrow belt across southwestern Franklin County and may be exposed within 15 miles of the camp (Plate 3). It is described in the Mississippi Geological Society Guidebook,

# SKETCH MAP OF CAMP VAN DORN AREA

## SHOWING LOCATION OF BORINGS AND SOME OUTCROPS

GEOLOGY AFTER MISSISSIPPI GEOLOGICAL SOCIETY

Most of the higher land surfaces are underlain by the Citronelle formation or younger terrace deposits which are not here shown

BASE FROM MISSISSIPPI STATE HIGHWAY MAPS
DECEMBER 9, 1942

SCALE

1 0 1 2 3 4 5 Miles

EXPLANATION

Pascagoula formation Miocene

FORT ADAMS MEMBER
Calcareous green clay, indurated-blue claystone, compact sand, and light coarse sand

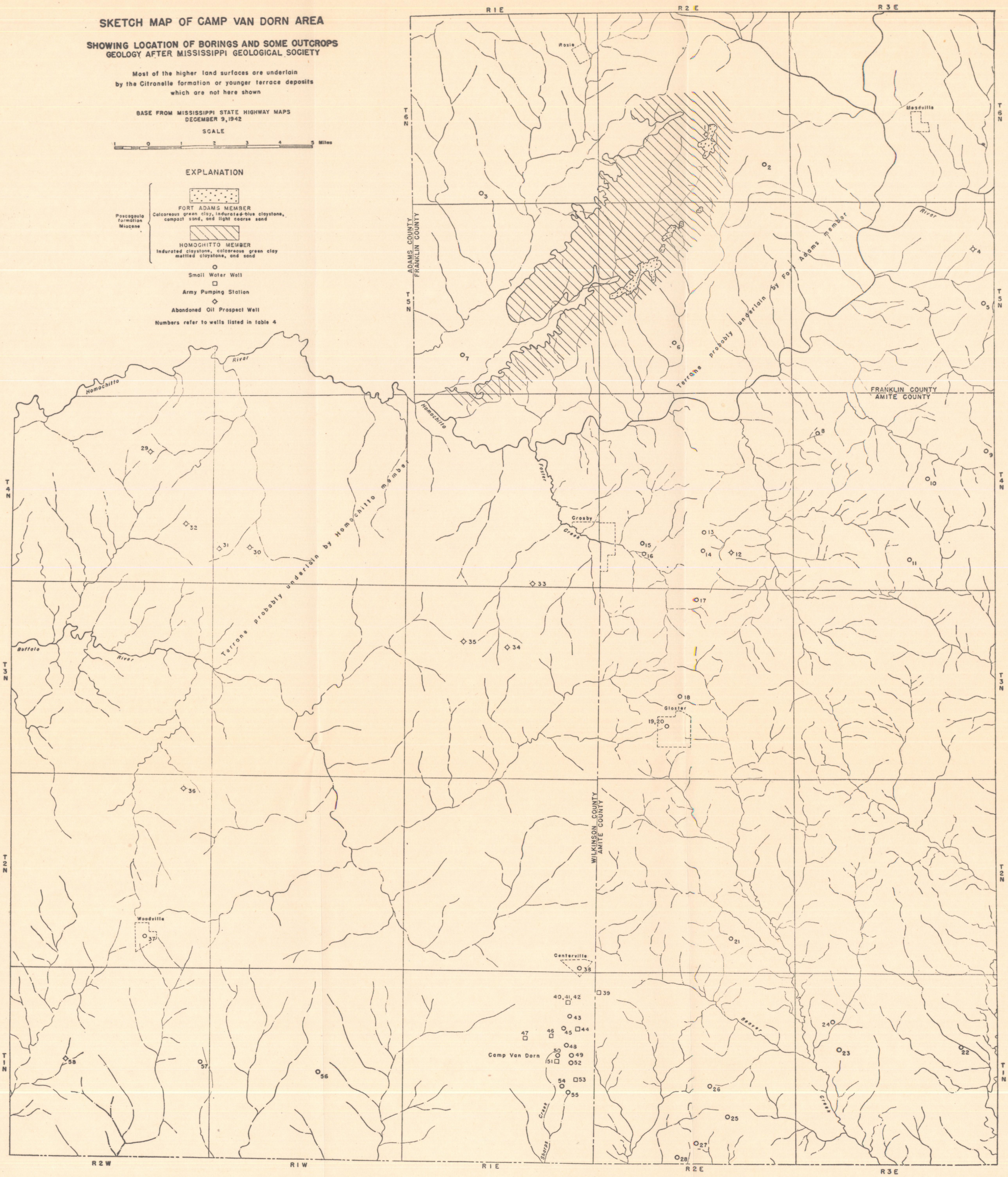
HOMOCHITTO MEMBER
Indurated claystone, calcareous green clay mottled claystone, and sand

○ Small Water Well

□ Army Pumping Station

◇ Abandoned Oil Prospect Well

Numbers refer to wells listed in table 4



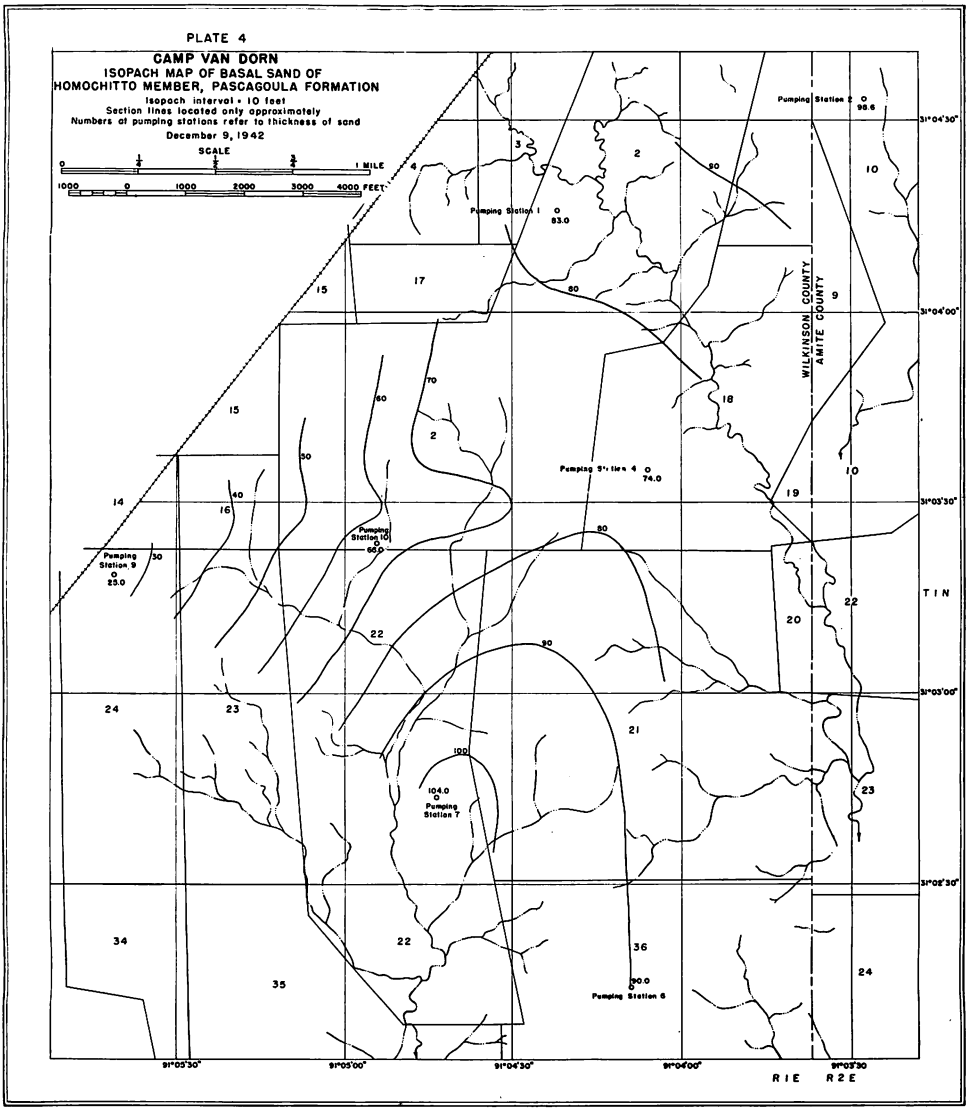


PLATE 4
CAMP VAN DORN
ISOPACH MAP OF BASAL SAND OF
HOMOCHITTO MEMBER, PASCAGOULA FORMATION
Isopach interval = 10 feet
Section lines located only approximately
Numbers at pumping stations refer to thickness of sand
December 9, 1942
SCALE
0 1/4 1/2 3/4 1 MILE
1000 0 1000 2000 3000 4000 FEET
Pumping Station 1 83.0
Pumping Station 2 98.6
Pumping Station 4 74.0
Pumping Station 6 90.0
Pumping Station 7 104.0
Pumping Station 9 23.0
Pumping Station 10 60.0
WILKINSON COUNTY
AMITE COUNTY
31°04'30"
31°04'00"
31°03'30"
31°03'00"
31°02'30"
91°05'30"
91°05'00"
91°04'30"
91°04'00"
91°03'30
T 1 N
R 1 E
R 2 E

Jackson to Recent Field Trip, illustration of the route in Franklin County, 1940,[18] as follows:

| | Thickness |
|---|---|
| *Claystone,* indurated | 2 |
| *Clay,* green calcareous; sand lenses | 75 |
| *Claystone,* mottled | 10 |
| *Clay,* green calcareous | 87 |
| *Sand,* and mottled claystone | 58 |
| *Clay,* green | ---- |

At Camp Van Dorn the depth interval of 227-419 feet at well 3, pumping station 1, that may be equivalent to this section, is composed of 122 feet of non-calcareous clay and silt and 70 feet of basal sand that becomes coarse at the bottom. The coarse grain size of this sand, compared to other sands beneath the camp, has already been shown (Table 3). The average thickness, at pumping station 9, is 25 feet (excluding 1 foot of shale near the middle); and the maximum thickness is 104 feet at pumping station 7. The distribution of thickness is shown on an isopach map of the sand (Plate 4). This map should be used with caution, as the thickness changes 13 feet in a horizontal distance of about 50 feet at pumping station 1. However, part of this change may be due to non-vertical borings.

This sand contains more quartz than the deeper sands, for orthoclase and microcline are less abundant, and plagioclase is even more rare. Of the heavy mineral grains, magnetite and associated oxides are most abundant. An increase in the amount of brown tourmaline and rutile was found in test well 3, pumping station 1. Epidote is rather plentiful among the heavy minerals in the sand at pumping station 2; zircon, coarse kyanite, and staurolite are plentiful at pumping station 7; and abundant zircon and zoisite are in the samples from pumping station 6. Zoisite was not observed in samples from other wells.

The shape of the surface whereon the Homochitto member was deposited is shown by contours (Plate 5). The concentration of heavy minerals described as a criterion for recognizing disconformities is not at all apparent in the lower part of the basal sand; contrary to the evidence of the fine gravel found in test well 3. Indeed, the structural appearance and the distribution of the heavy minerals suggest that deposition from lower Pascagoula time into Homochitto

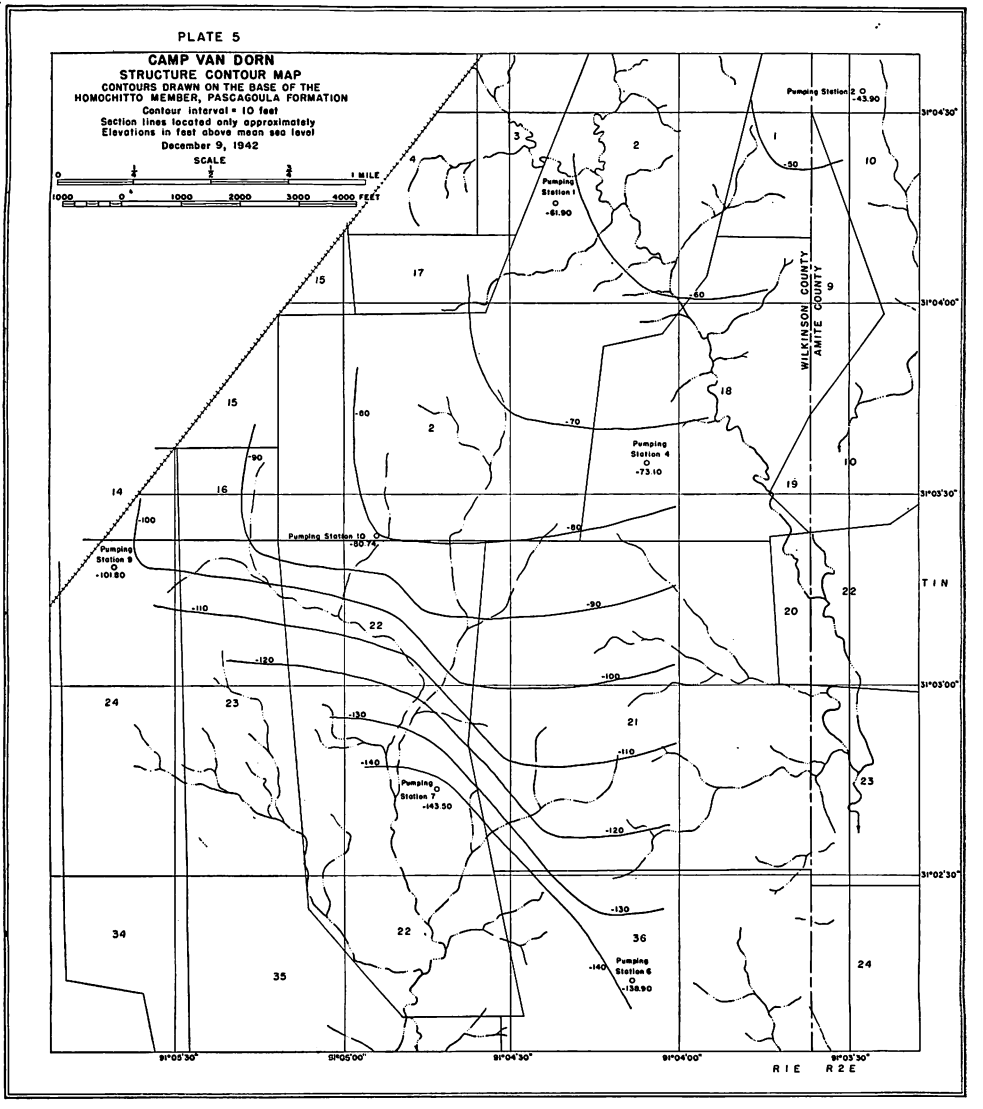


PLATE 5
CAMP VAN DORN
STRUCTURE CONTOUR MAP
CONTOURS DRAWN ON THE BASE OF THE
HOMOCHITTO MEMBER, PASCAGOULA FORMATION
Contour interval = 10 feet
Section lines located only approximately
Elevations in feet above mean sea level
December 9, 1942
SCALE
1 MILE
1000 0 1000 2000 3000 4000 FEET
Pumping Station 1 -61.90
Pumping Station 2 -43.90
Pumping Station 4 -73.10
Pumping Station 6 -138.90
Pumping Station 7 -143.50
Pumping Station 9 -101.80
Pumping Station 10 -80.74
WILKINSON COUNTY
AMITE COUNTY
T 1 N
R 1 E
R 2 E
31°04'30"
31°04'00"
31°03'30"
31°03'00"
31°02'30"
91°05'30"
91°05'00"
91°04'30"
91°04'00"
91°03'30"

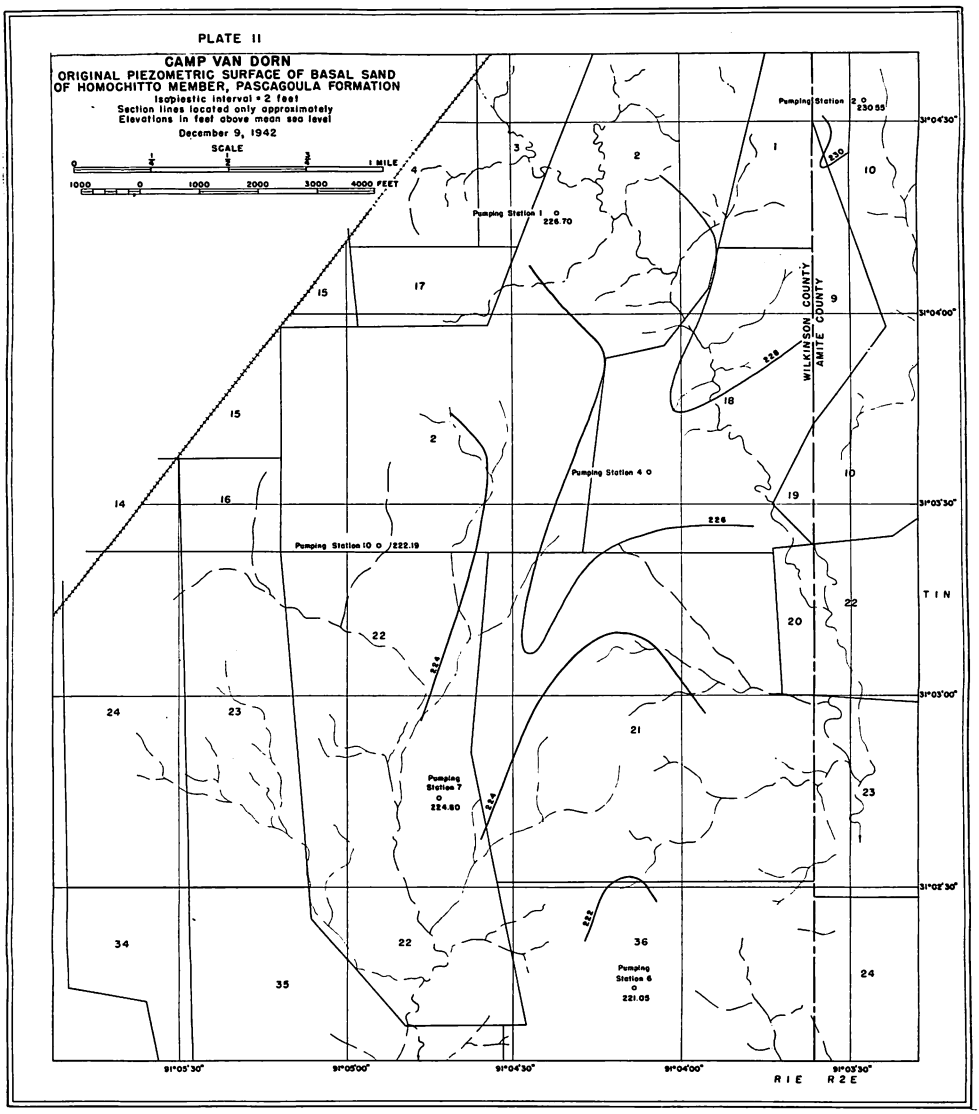


PLATE II
CAMP VAN DORN
ORIGINAL PIEZOMETRIC SURFACE OF BASAL SAND
OF HOMOCHITTO MEMBER, PASCAGOULA FORMATION
Isopiestic interval = 2 feet
Section lines located only approximately
Elevations in feet above mean sea level
December 9, 1942
SCALE
1 MILE
1000 0 1000 2000 3000 4000 FEET
Pumping Station 1 o 226.70
Pumping Station 2 o 230.55
Pumping Station 4 o
Pumping Station 10 o 222.19
Pumping Station 7 o 224.80
Pumping Station 6 o 221.05
WILKINSON COUNTY
AMITE COUNTY
T 1 N
R 1 E
R 2 E
31°04'30"
31°04'00"
31°03'30"
31°03'00"
31°02'30"
91°05'30"
91°05'00"
91°04'30"
91°04'00"
91°03'30"

time was continuous, or nearly so, whereas the stratigraphic break at the base of the Pascagoula formation may represent a long period of erosion.

### HYDROLOGY OF THE BASAL SAND OF THE HOMOCHITTO MEMBER

Of the nine wells that furnish the camp supply six are developed in the basal sand of the Homochitto member. They are situated along the periphery of an area 1.45 miles wide and 2.7 miles long. The minimum distance between adjacent wells is 4,100 feet, the maximum distance is 5,150 feet, and the average distance is 4,530 feet (Plates 4, 5). Another well has been developed in this sand for a municipal supply at Centreville following completion of the wells at the camp.

The average original static water level, prior to pumping other than preliminary tests, was 223.8 feet above mean sea level, a position that was 105.5 feet higher than the original static level of water derived from the Catahoula sandstone at pumping station 1, and 65.5 feet higher than the static level of water derived from the sand at the base of the Pascagoula formation at pumping station 9.

A map of the piezometric or pressure surface (prepared by connecting points of static water level of equal altitude above mean sea level) indicates a direction of movement of the water in this sand from northeast toward the southwest (Plate 11).

The permeability of 23 samples from six wells averages 967 in Meinzer's units or approximately the same as the average of the four samples from the Catahoula sandstone (Table 3).

### RESULTS OF PUMPING TESTS

The principal results of one of the two pumping tests made of the six wells screened in the sand of the Homochitto member are best shown in graphic form (Plate 12). The coefficients of transmissibility and storage obtained from the application of the Thiem formula and of the non-equilibrium formula to the pumping tests are given in tabular form (Tables 4, 5, 6).

The Thiem formula gives a single value for the coefficient of transmissibility in each test for each set of two observation wells. It is based on the difference between the drawdowns or recoveries in the two observation wells caused by pumping or shutting down another well. Any change in thickness or character of the aquifer which disrupts uniform radial flow of the water is likely to cause the

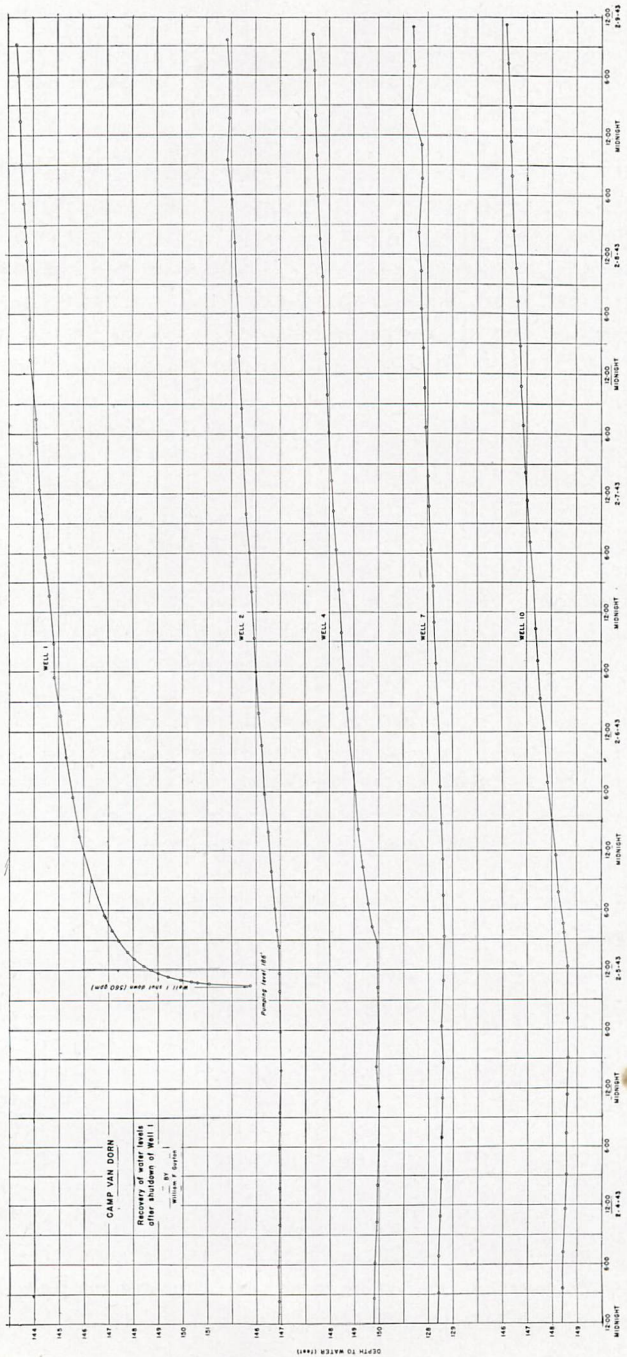



Plate 12.—Recovery of water levels after shutdown of Well 1.

application of the Thiem formula to be in error, and the error may be great if the difference in drawdowns is small or if the observation wells are not in a straight line with and on the same side of the pumped well.

A study of the isopach map of the basal sand of the Homochitto member (Plate 4) indicates that the coefficients determined by the Thiem formula from the pumping tests of the six Homochitto wells are probably, on the whole, inaccurate. The four coefficients which were determined from observation wells most nearly in a straight line with and on the same side of the pumped well are denoted in Table 4 by an asterisk. Of these, the two coefficients involving wells 10 and 7 are probably erroneous because there is such a great difference between the thicknesses of the formation at the two wells. The two remaining coefficients of transmissibility, one determined from each of the two tests, involving wells with good alignment are 65,000 and 69,000. Because of the alignment of the wells in a north-northeasterly direction, these coefficients probably are not influenced very much by the general thinning of the sand in a west-northwesterly direction.

TABLE 4

COEFFICIENTS OF TRANSMISSIBILITY COMPUTED WITH THIEM'S FORMULA FROM PUMPING TESTS OF CAMP VAN DORN WELLS. BASAL SAND OF THE HOMOCHITTO MEMBER.

| Date | Well turned on or off | Observation wells (idle) | Coefficient of transmissibility, T |
|---|---|---|---|
| 1943 | | | |
| Jan. 30 to Feb. 5 | 6 on | 7, 10 | 172,000* |
| " | " | 10, 2 | 54,000 |
| " | " | 7, 2 | 83,000 |
| " | " | 7, 4 | 112,000 |
| " | " | 4, 2 | 65,000* |
| " | " | 4, 10 | inaccurate |
| Feb. 5 to Feb. 9 | 1 off | 4, 2 | 40,000 |
| " | " | 2, 7 | 86,000 |
| " | " | 4, 7 | 69,000* |
| " | " | 4, 10 | 174,000 |
| " | " | 10, 7 | 48,000* |
| " | " | 2, 10 | inaccurate |

* Coefficients determined from wells most nearly in straight line with and on the same side of pumped well.

TABLE 5

COEFFICIENTS OF TRANSMISSIBILITY AND STORAGE COMPUTED WITH NON-EQUILIBRIUM FORMULA FROM PUMPING TESTS OF CAMP VAN DORN WELLS—INTERFERENCE BETWEEN WELLS. BASAL SAND OF THE HOMOCHITTO MEMBER.

| Date of test | Well turned on or off | Observation well (idle) | Coefficient of transmissibility (T) | Coefficient of storage (S) | Time after well turned on or off (hours) | Alignment of points with type curve | Average T | Average S |
|---|---|---|---|---|---|---|---|---|
| 1943 | | | | | | | | |
| Jan. 30 to Feb. 5 | 6 on | 7 | 51,500 | 0.00057 | 8-146 | Good | | |
| " | " | 10 | 45,500 | 0.00027 | 14-146 | Good | | |
| " | " | 4 | 49,600 | 0.00031 | 14-146 | Good | 49,200 | 0.00038 |
| " | " | 2 | 73,000 | 0.00030 | 26-146 | Poor | | |
| Feb. 5 to Feb. 9 | 1 off | 2 | 50,900 | 0.00042 | 7- 50 | Good | | |
| " | " | 2 | 42,500 | 0.00044 | 50- 98 | Good | | |
| " | " | 4 | 60,500 | 0.00038 | 7- 32 | Good | | |
| " | " | 4 | 41,100 | 0.00043 | 32- 98 | Good | | |
| " | " | 10 | 72,900 | 0.00027 | 5- 20 | Good | | |
| " | " | 10 | 39,800 | 0.00028 | 20- 98 | Good | | |
| " | " | 7 | 36,800 | 0.00028 | 26- 98 | Good | 40,000 | 0.00036 |
| | | | | | Average: | | 44,600 | 0.00037 |

The non-equilibrium formula may give different coefficients of transmissibility and storage at different times during a test. Such is the case in the cessation of pumping well 1 and applying the formula to the recovery of water levels in it and the other wells. The changing coefficients are probably due to lateral changes in the characteristics of the aquifer. The coefficients determined from the first part of the tests are more representative of the aquifer immediately surrounding well 1, while the coefficients determined from the last part of the test are affected by the characteristics of the aquifer both immediately surrounding well 1 and at greater distances from it. The coefficients obtained from the last parts of the tests are believed to be more applicable for determining long-term water-level drawdowns unless definite boundaries and changes in the aquifer are found and taken into account. No definite boundary can be assumed for the thinning of the Homochitto to the west of Camp Van Dorn, so the coefficients obtained from the last parts of the tests are used here, although those determined from the first parts of the tests are probably more nearly correct and would more nearly conform to the coefficients obtained by the Thiem formula. The average coefficients of transmissibility obtained from the interference tests with the non-equilibrium formula (using the last parts of the tests) is 44,600 and the average coefficient of storage is 0.00037 (Table 5). The coefficient of transmissibility determined from the recovery test on well 1 is 32,800 gallons a day per foot for the latter part of the test (Table 6).

When the wells were first developed by the contractor, pumping tests were made and recoveries of water levels in the wells observed. The pumping was irregular and measurements of depth to water taken only with an air line. However, an attempt has been made to apply the non-equilibrium formula to the recoveries (Table 6). The periods of observation of recovery are short and the coefficients are probably higher than would be obtained for longer periods of observation. The average coefficient of transmissibility determined from these original tests is 49,300.

The coefficients of transmissibility determined from the basal sand of the Homochitto range from 32,800 to as high as 73,000. While part of this wide range may be accounted for by the length of the tests and the general thinning of the sand to the west, a part of it is probably caused by local variations in the aquifer. Because the re-

sults of the tests are not consistent, computations of future drawdowns using average coefficients will probably be somewhat inaccurate. Yet, without making much more elaborate tests of the aquifer, the use of average coefficients of transmissibility and storage in the non-equilibrium formula is the best available way of estimating future drawdowns of water levels caused by pumping from the Camp Van Dorn wells. The average coefficients assumed from the test results for the purpose of estimating future drawdowns are 45,000 for transmissibility and 0.0004 for storage.

TABLE 6

COEFFICIENTS OF TRANSMISSIBILITY COMPUTED WITH NON-EQUILIBRIUM FORMULA FROM PUMPING TESTS OF CAMP VAN DORN WELLS—RECOVERY OF WATER LEVELS IN PUMPED WELLS AFTER PUMPS WERE SHUT DOWN. BASAL SAND OF THE HOMOCHITTO MEMBER.

| Date of test | Well | Coefficient of transmissibility (T) | Time after well was shut down (hours) | Alignment of data |
|---|---|---|---|---|
| 1943 | | Geological Survey Tests | | |
| Feb. 5 to Feb. 9 | 1 | 47,600 | 0.1-30 | Good |
| Feb. 5 to Feb. 9 | 1 | 32,800 | 30-95 | Good |
| 1942 | | Contractor's Tests | | |
| May 12 | 1 | 46,000 | 0-8.5 | Fair |
| July 10 | 2 | 39,400 | 0-6.5 | Poor |
| July 31 | 4 | 62,000 | 0-10 | Fair |
| September 23 | 6 | 34,100 | 0-6 | Poor |
| July 4 | 7 | 44,700 | 0-8.5 | Poor |
| September 10 | 10 | 69,600 | 0-5 | Poor |
| | Average: | 49,300 | | |

The curves on Plate 13 were compiled from these average coefficients. They show, according to the non-equilibrium formula, the theoretical drawdown in water levels at distances ranging from 100 to 38,000 feet from a well, produced by pumping the well at the rate of 1,000 gallons a minute, after 1 month, 3 months, 1 year, and 3 years of continuous pumping. The drawdown is proportional to the rate of pumping. For instance, to compute the drawdown produced by pumping 600 or 800 gallons a minute the drawdown indicated on the graph should be multiplied by 0.6 or 0.8 respectively.

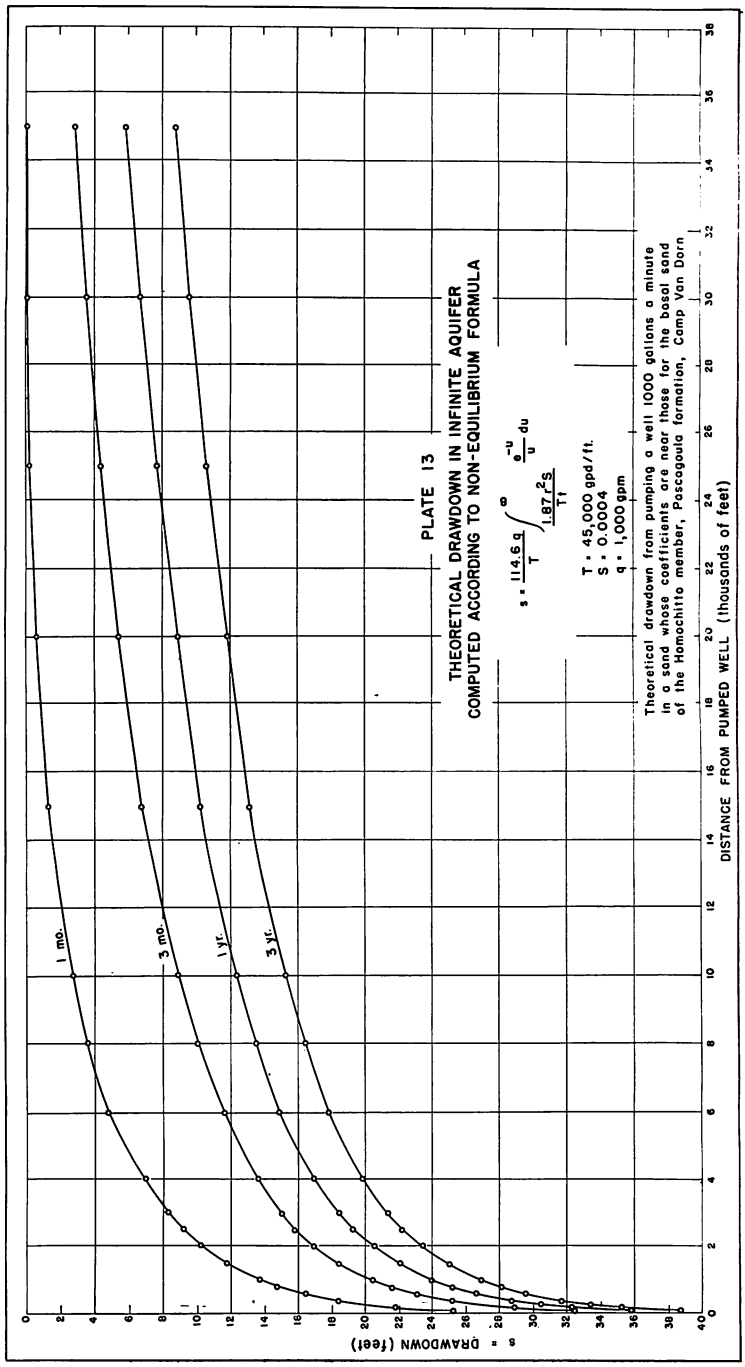


PLATE 13
THEORETICAL DRAWDOWN IN INFINITE AQUIFER
COMPUTED ACCORDING TO NON-EQUILIBRIUM FORMULA
$s = \frac{114.6\,q}{T} \int_{\frac{1.87\,r^2 S}{Tt}}^{\infty} \frac{e^{-u}}{u}\,du$
T = 45,000 gpd/ft.
S = 0.0004
q = 1,000 gpm
Theoretical drawdown from pumping a well 1000 gallons a minute in a sand whose coefficients are near those for the basal sand of the Homochitto member, Pascagoula formation, Camp Van Dorn
1 mo.
3 mo.
1 yr.
3 yr.
s = DRAWDOWN (feet)
DISTANCE FROM PUMPED WELL (thousands of feet)

### EFFECT ON WATER-LEVEL DRAWDOWNS CAUSED BY BOUNDARIES OF AQUIFER

As explained, the curves on Plate 13 are based on the assumption that the aquifer is of infinite areal extent and constant transmissibility. Therefore, before a prediction can be made from the curves of the decline in water level caused by the withdrawal of a known amount of water, the lateral boundaries and changes in thickness and character of the aquifer must be considered.

The thinning of the basal sand of the Homochitto member to the west of Camp Van Dorn wells is close enough to affect the coefficients determined from the pumping tests so that in computing drawdowns with the average coefficients, the thinning has already been partly compensated. However, it probably will still cause the estimated drawdowns to be somewhat too small, for the pumping tests were too short for the full effect to be shown by the coefficients. Just how much the additional effect will be cannot be ascertained, but the proportional increase in drawdown probably will not be great.

In an aquifer such as the basal sand of the Homochitto member in the Camp Van Dorn area which is pumped at a distance of many miles from the outcrop, the water levels in wells are not influenced by the position of the area of intake during the first few months or years after pumping is begun; but, as time goes on, this position becomes more and more a determining factor in the rate of decline in water levels. The same influence applies to any other type of aquifer boundary, such as a fault or lensing out of a part or all of the sand, or any geologic change near or far from the wells. Replenishment in the area or recharge tends ultimately to decrease the rate of decline caused by pumping from wells, while faulting or lensing out of the sand has the opposite effect and tends to increase the rate of decline. The length of time it takes for the position of the aquifer's boundary to affect noticeably the decline of water levels increases with the distance of the boundary from the wells, and the amount of its effect decreases with the distance.

The nearest outcrop of the Homochitto sand is exposed about 15 miles northwest of the Camp Van Dorn wells. This distance is great enough so that the computed drawdowns for one year, on the basis of an infinite aquifer, in the Camp Van Dorn wells are practically not affected. During the next two years, however, the effect of replenishment at the outcrop should begin to show up by causing a

smaller rate of decline of water levels than that computed on the basis of an infinite aquifer, unless the more adjacent outcrops are sealed from the camp supply by faulting. The actual decline between the end of one and three years of contiuous pumping may be only about one-half that computed. After three years of continuous pumping there should be practically no decline.

### DRAWDOWN OF WATER LEVELS

For the purpose of estimating drawdowns of water levels, a continuous rate of pumping of 500 gallons a minute from each of the six Homochitto wells is assumed. This constant withdrawal from the Homochitto sand of 3,000 gallons a minute, or 4,320,000 gallons a day is probably more than will actually be pumped in the near future. Drawdowns are directly proportional to the pumping rates, however, and the estimates of drawdowns given here may easily be adjusted to the total pumping rates so long as all the wells are pumped at equal rates. If it is desired to vary the rates of pumping from individual wells, additional computations of the drawdowns should be made by the use of the non-equilibrium formula.

In determining the drawdown in a well due to its own pumping, the non-equilibrium formula is likely to give results that are in error. The reason is that it is very difficult to determine the effective radius of the artificial or natural gravel-walled well; Darcy's law possibly breaks down near the well face as a result of too-great velocities; and the "permeability" of the well screen may not be the same as or greater than that of the sand. Therefore, in making the computations for Table 7, the specific capacities of the wells were used in determining the drawdowns caused by the wells themselves during the first day after pumping is assumed to have begun. This use eliminates the errors encountered by the non-equilibrium formula. The non-equilibrium formula is then used for the drawdowns after the first day and should give satisfactory results if its assumptions are fulfilled.

The specific capacity of a well is defined as the quantity of water that well will yield, in gallons a minute, for each foot of drawdown in the well. It may be determined for any interval after pumping is begun. Specific capacities are often used by engineers to compare wells. It is usually helpful to compare wells by specific capacities in a given locality which draw from a single formation, but often misleading to make comparisons of wells in different formations or

in the same formation in different areas. Boundaries of the aquifer often play an important part in the determination of drawdown, and the lengths of time of continuous pumping for which specific capacities are determined are usually too short to include the effects of the boundaries.

The specific capacities of the Homochitto wells of the basal sand member at Camp Van Dorn after a day of pumping are:

| Well | Specific capacity (gallons a minute per foot of drawdown) |
|---|---|
| 1 | 13.7 |
| 2 | 13.9 |
| 4 | 10.8 |
| 6 | 15.5 |
| 7 | 15.9 |
| 10 | 17.7 |

The figures were determined from these tests by the Geological Survey for wells 1 and 6 and from tests by the drilling contractor for wells 2, 4, 7, and 10.

The estimated drawdowns of water levels below the original levels anticipated in the Camp Van Dorn wells as a result of continuous pumping from the wells at a rate of 500 gallons a minute from each are given in tabular form (Table 7). The drawdowns are computed by the non-equilibrium formula, and the effect of the outcrop is taken into account by the image well theory. The effects of other boundaries are not compensated, except that as already explained. The thinning of the Homochitto sand to the west is partly compensated by averaging the coefficients of transmissibility and storage as determined from the pumping tests.

In applying the drawdown figures (Table 7), it should be pointed out again that it is quite possible that they are correct only in the right order of magnitude. However, they are the best available, and, assuming that they are approximately correct, they show that the water levels in the six Homochitto wells will be lowered to points near the tops of the pump bowls after 3 years of continuous pumping of 500 gallons a minute from each well. Most of the drawdowns will take place within the first month. Only in well 4 does it appear that the bowls may have to be lowered, and the amount of lowering indicated to be necessary is within the limits of error for the drawdown

figures. Also, since it is doubtful that it will be necessary to pump the wells at an average rate as great as 3,000 gallons a minute, the drawdowns will probably be less than estimated and none of the pump bowls will need to be lowered.

If more than 3,000 gallons a minute is desired from the Homochitto sand, increasing the rates of withdrawal from the present six wells rather than drilling new wells should be considered. With proportionally increased drawdown, each well should yield considerably more than 500 gallons a minute. The limiting depths to which the pumping levels may be lowered should be taken as the depths to the top of the water-bearing sand.

TABLE 7

ESTIMATED DRAWDOWN OF WATER LEVELS IN CAMP VAN DORN WELLS BELOW ORIGINAL WATER LEVELS AND PRESENT PUMP BOWL SETTINGS. BASAL SAND OF THE HOMOCHITTO MEMBER.

| Well | 1 | 2 | 4 | 6 | 7 | 10 |
|---|---|---|---|---|---|---|
| Elevation of land surface above sea level (feet) | 355.1 | 364.6 | 356.9 | 337.1 | 332.5 | 354.3 |
| Original depth below surface to static water level (feet) | 128.4 | 134.1 | 139.3 | 116.1 | 107.7 | 132.1 |
| Assumed rate of continuous pumping (gallons a minute) | 500 | 500 | 500 | 500 | 500 | 500 |
| Estimated drawdown below original water level at end of 1-mo. (feet) | 60 | 56 | 72 | 53 | 55 | 53 |
| Estimated drawdown below original water level at end of 3-mos. (feet) | 69 | 65 | 81 | 62 | 64 | 62 |
| Estimated drawdown below original water level at end of 1 year (feet) | 78 | 74 | 90 | 71 | 73 | 71 |
| Estimated drawdown below original water level at end of 3 years (feet) | 83 | 79 | 95 | 76 | 78 | 76 |
| Depth below pump base to top of pump bowls (feet) * | 220 | 220 | 220 | 190 | 220 (?) | 200 |
| Depth below land surface to top of water-bearing sand | 334 | 310 | 332 | 386 | 372 | 369 |

* Pump base of each well is about 1 to 2 feet above land surface.

## PASCAGOULA FORMATION, FORT ADAMS MEMBER

### GENERAL GEOLOGY

The Fort Adams member crops out in an area that parallels the outcrops of the Homochitto member which it overlies (Plate 3). The name is taken from the excellent exposures along the bluff above

Fort Adams in southwestern Wilkinson County. Supposedly the unit can be followed in a northeasterly direction from Fort Adams across Wilkinson County into Franklin County. The Guidebook of the Mississippi Geological Society[18] describes the Fort Adams member as follows:

| | Thickness |
|---|---|
| *Clay,* calcareous and green | ---- |
| *Claystone,* indurated mottled blue | 24 |
| *Sand,* compact | 8 |
| *Sand,* mottled, and indurated *clay* | 56 |
| *Sand,* light coarse | 40 |

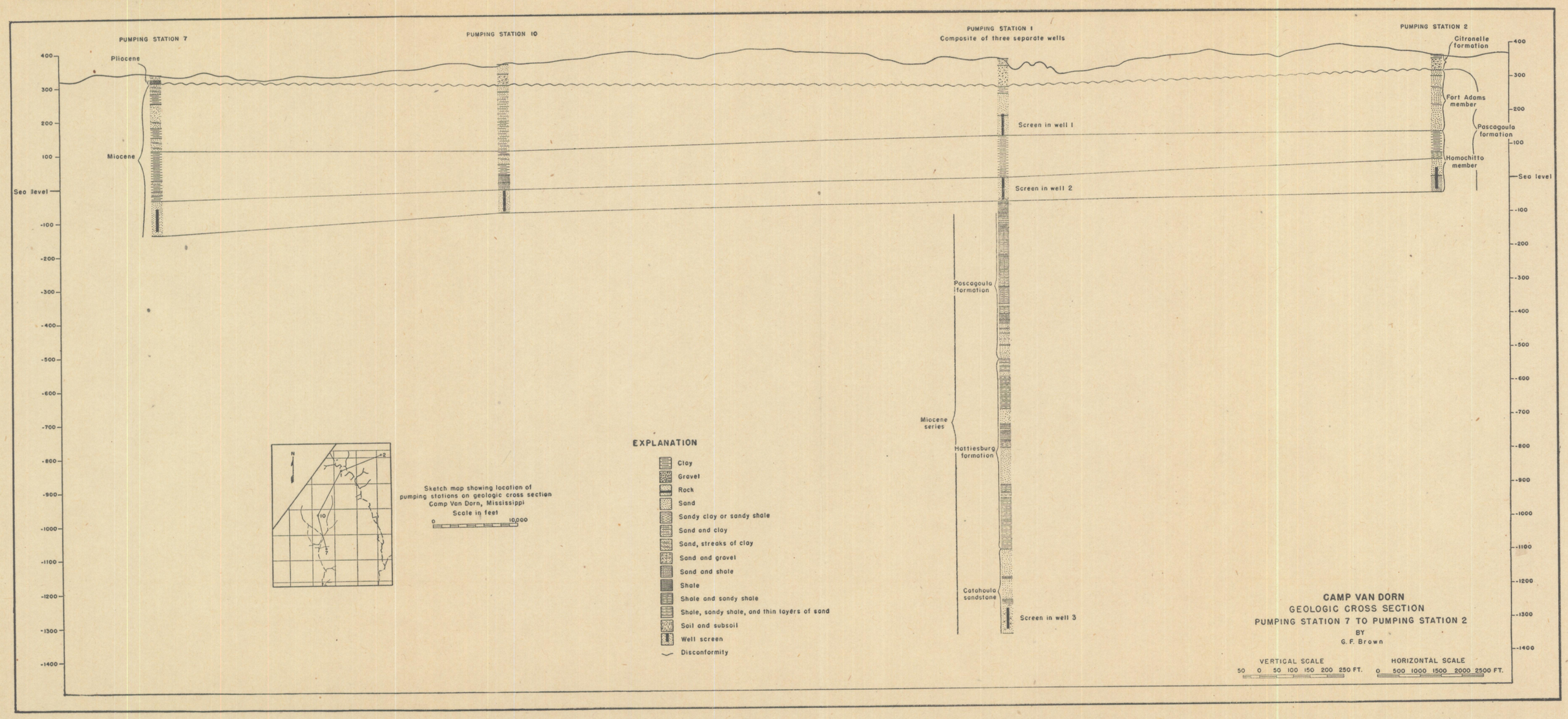
At Camp Van Dorn the Fort Adams member is considered to consist of the sands and clay directly below the surface upon which the terrace sands and gravels were deposited and to extend down to a depth of about 230 feet (Plates 8, 9, 10). At test well 3, pumping station 1, the thickness is 146 feet. The clay is waxy; the sand is mostly angular to rounded quartz and contains some mica. The sediments appear to be non-continuous and more heterogeneous than the underlying Homochitto member. The basal sandy phase of the Fort Adams contains numerous lenses or pockets of clay. All the minerals of the overlying Citronelle are also present in this member, because of contamination, or because of the derivation of the Citronelle in part from the Fort Adams, or because of the derivation of both from the same hinterland. Orthoclase, microcline, and sodic plagioclase feldspars are present in minor amounts in both sands. The iron minerals are ilmanite, magnetite, and hematite, so that water in the Fort Adams member is in an oxidized zone.

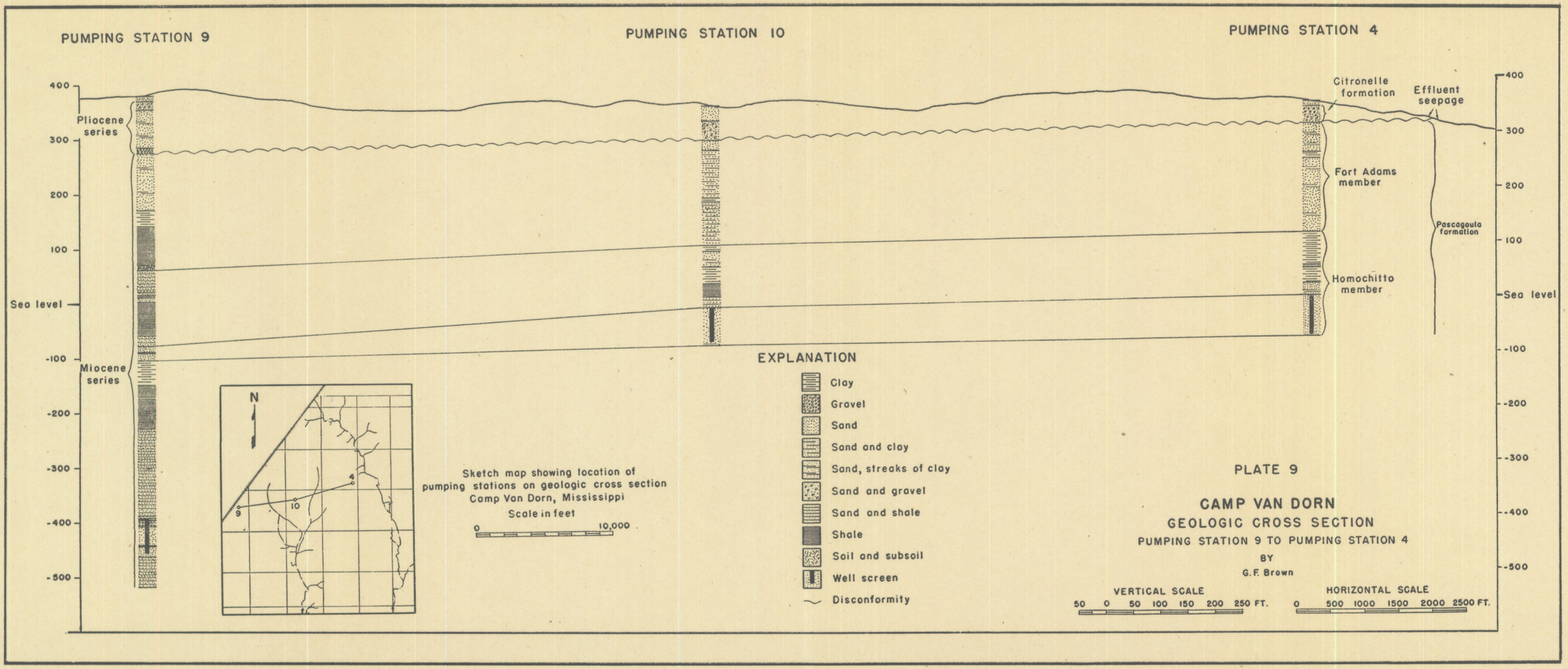
Mechanical analyses of samples from the Fort Adams sands are summarized in tabular form (Table 3).

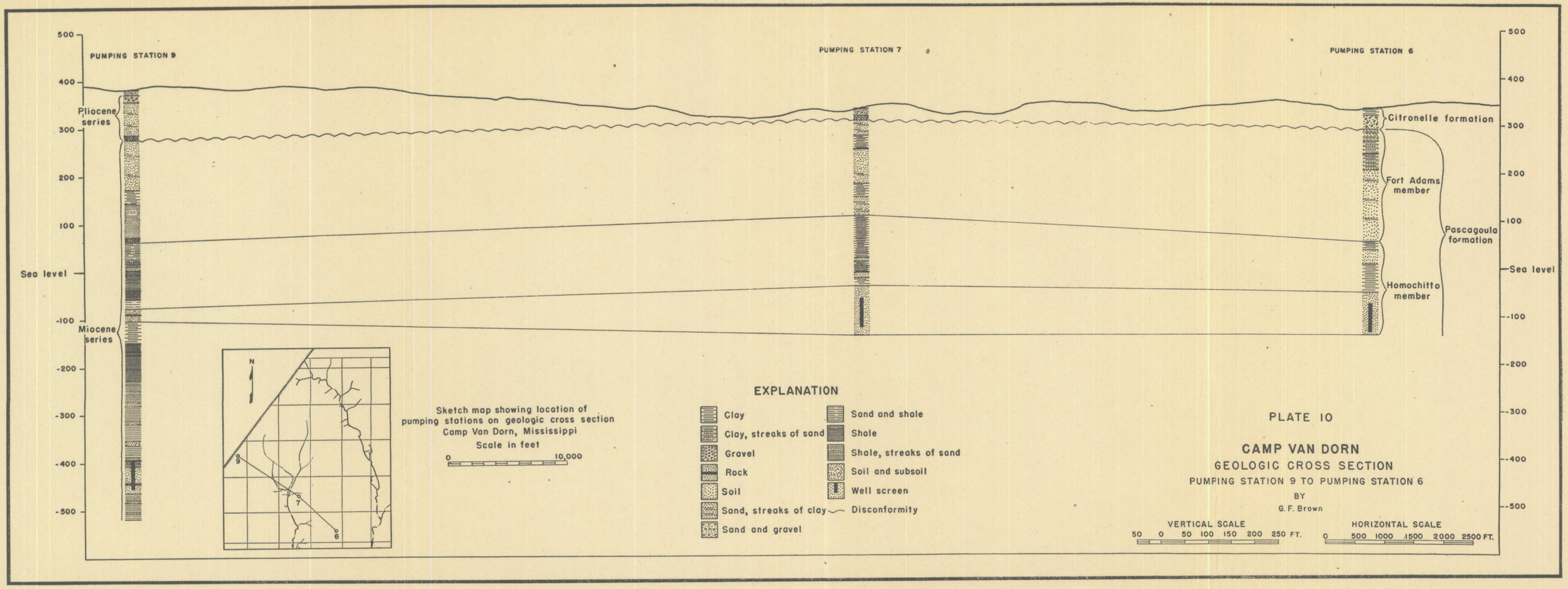
The surface upon which the Fort Adams member was deposited is shown by means of contour lines (Plate 6). The general inclination is to the southwest, as was noted for the Homochitto sand base, but there is not so much relief, and a long structural ridge seems to be much more prominent on this map.

### HYDROLOGY OF THE FORT ADAMS MEMBER

The coefficients of permeability from eight samples of sand from the Fort Adams member range from 278 to 960 and average 637 or about two-thirds the permeability of the Homochitto member. This estimate is probably too high, because the clay, known to be present,


PUMPING STATION 7
PUMPING STATION 10
PUMPING STATION 1
Composite of three separate wells
PUMPING STATION 2
Pliocene
Miocene
Citronelle formation
Fort Adams member
Pascagoula formation
Homochitto member
Screen in well 1
Screen in well 2
Screen in well 3
Pascagoula formation
Miocene series
Hattiesburg formation
Catahoula sandstone
Sea level
400
300
200
100
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
-1100
-1200
-1300
-1400
EXPLANATION
Clay
Gravel
Rock
Sand
Sandy clay or sandy shale
Sand and clay
Sand, streaks of clay
Sand and gravel
Sand and shale
Shale
Shale and sandy shale
Shale, sandy shale, and thin layers of sand
Soil and subsoil
Well screen
Disconformity
N
Sketch map showing location of pumping stations on geologic cross section Camp Van Dorn, Mississippi
Scale in feet
0
10,000
CAMP VAN DORN
GEOLOGIC CROSS SECTION
PUMPING STATION 7 TO PUMPING STATION 2
BY
G. F. Brown
VERTICAL SCALE
50 0 50 100 150 200 250 FT.
HORIZONTAL SCALE
0 500 1000 1500 2000 2500 FT.


PUMPING STATION 9
PUMPING STATION 10
PUMPING STATION 4
400
300
200
100
Sea level
-100
-200
-300
-400
-500
Pliocene series
Miocene series
Citronelle formation
Effluent seepage
Fort Adams member
Homochitto member
Pascagoula formation
N
9
10
4
Sketch map showing location of pumping stations on geologic cross section Camp Van Dorn, Mississippi
Scale in feet
0
10,000
EXPLANATION
Clay
Gravel
Sand
Sand and clay
Sand, streaks of clay
Sand and gravel
Sand and shale
Shale
Soil and subsoil
Well screen
Disconformity
PLATE 9
CAMP VAN DORN
GEOLOGIC CROSS SECTION
PUMPING STATION 9 TO PUMPING STATION 4
BY
G.F. Brown
VERTICAL SCALE
50 0 50 100 150 200 250 FT.
HORIZONTAL SCALE
0 500 1000 1500 2000 2500 FT.


PUMPING STATION 9
PUMPING STATION 7
PUMPING STATION 6
500
400
300
200
100
Sea level
-100
-200
-300
-400
-500
Pliocene series
Miocene series
Citronelle formation
Fort Adams member
Pascagoula formation
Homochitto member
N
9
7
6
Sketch map showing location of pumping stations on geologic cross section Camp Van Dorn, Mississippi
Scale in feet
0
10,000
EXPLANATION
Clay
Clay, streaks of sand
Gravel
Rock
Soil
Sand, streaks of clay
Sand and gravel
Sand and shale
Shale
Shale, streaks of sand
Soil and subsoil
Well screen
Disconformity
PLATE 10
CAMP VAN DORN
GEOLOGIC CROSS SECTION
PUMPING STATION 9 TO PUMPING STATION 6
BY
G. F. Brown
VERTICAL SCALE
50 0 50 100 150 200 250 FT.
HORIZONTAL SCALE
0 500 1000 1500 2000 2500 FT.

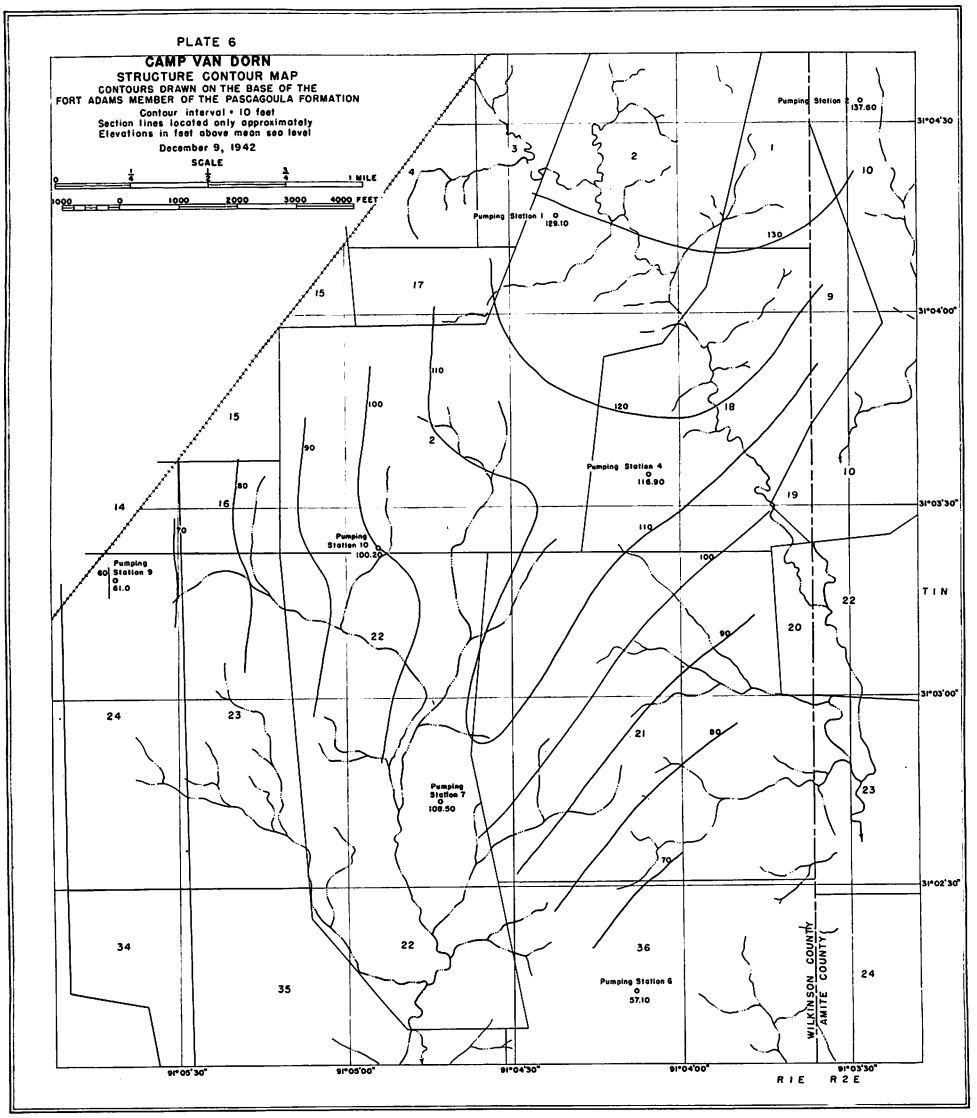


PLATE 6
CAMP VAN DORN
STRUCTURE CONTOUR MAP
CONTOURS DRAWN ON THE BASE OF THE
FORT ADAMS MEMBER OF THE PASCAGOULA FORMATION
Contour interval = 10 feet
Section lines located only approximately
Elevations in feet above mean sea level
December 9, 1942
SCALE
1 MILE
4000 FEET
Pumping Station 1 129.10
Pumping Station 2 137.60
Pumping Station 4 116.90
Pumping Station 6 37.10
Pumping Station 7 109.50
Pumping Station 9 61.0
Pumping Station 10 100.20
WILKINSON COUNTY
AMITE COUNTY
T1N
R1E
R2E
31°04'30"
31°04'00"
31°03'30"
31°03'00"
31°02'30"
91°05'30"
91°05'00"
91°04'30"
91°04'00"
91°03'30"

is largely removed in the laboratory. Well 1, pumping station 1, was developed in this sand to test it and also to furnish part of the camp supply. The original static water level in the well was 43 feet below the surface or 310.5 feet above mean sea level.

A pumping test of this well as one of the series was made between January 26 and February 10, 1943. The water level in the well after approximately a week of constant pumping at about 245 gallons a minute was 140 feet below the pump base. The level recovered 80 feet in the first day after cessation of pumping and about 6 1/2 feet in the next 2 days. The specific capacity for 1 day's pumping was 3.1 gallons a minute per foot of drawdown. Theis' nonequilibrium formula was used to analyze the rate of recovery of the water level after pumping ceased and gave a coefficient of transmissibility of 3,900. An analysis of the contractor's original pumping test gave the same coefficient.

The depth to the top of the water-bearing sand from the land surface is 104 feet. The pumping level of about 138 feet recorded during the pumping test, therefore, shows an unwatering of the sand immediately around the well and a corresponding decrease in the transmissibility. If the well is pumped continuously at a rate of 245 gallons a minute, the pumping level will probably decline considerably below 140 feet, with a resulting greater unwatering of the sand, a decrease in its transmissibility, and a decrease in the specific capacity of the well. It appears to be advisable, therefore, to pump the well only when necessary and then for as short a period as possible. This program will allow the water level to recover between pumping periods and will keep the pumping level higher than it would be if the well were pumped continuously. It will probably keep the pump from breaking suction, which would necessitate a long recovery period before pumping could be commenced again at the same rate. If the well is pumped at a rate considerably less than 245 gallons a minute, however, it will probably be safe to pump it continuously.

## PLIOCENE (?)

### CITRONELLE FORMATION

Sands, clays, and gravels cap the hills throughout most of south Mississippi. These sediments have many of the features of terrace deposits, and at Camp Van Dorn they were water-laid on a fairly even surface which now slopes to the west (Plate 7). Here the Citronelle formation is about 100 feet thick. Its light-weight minerals

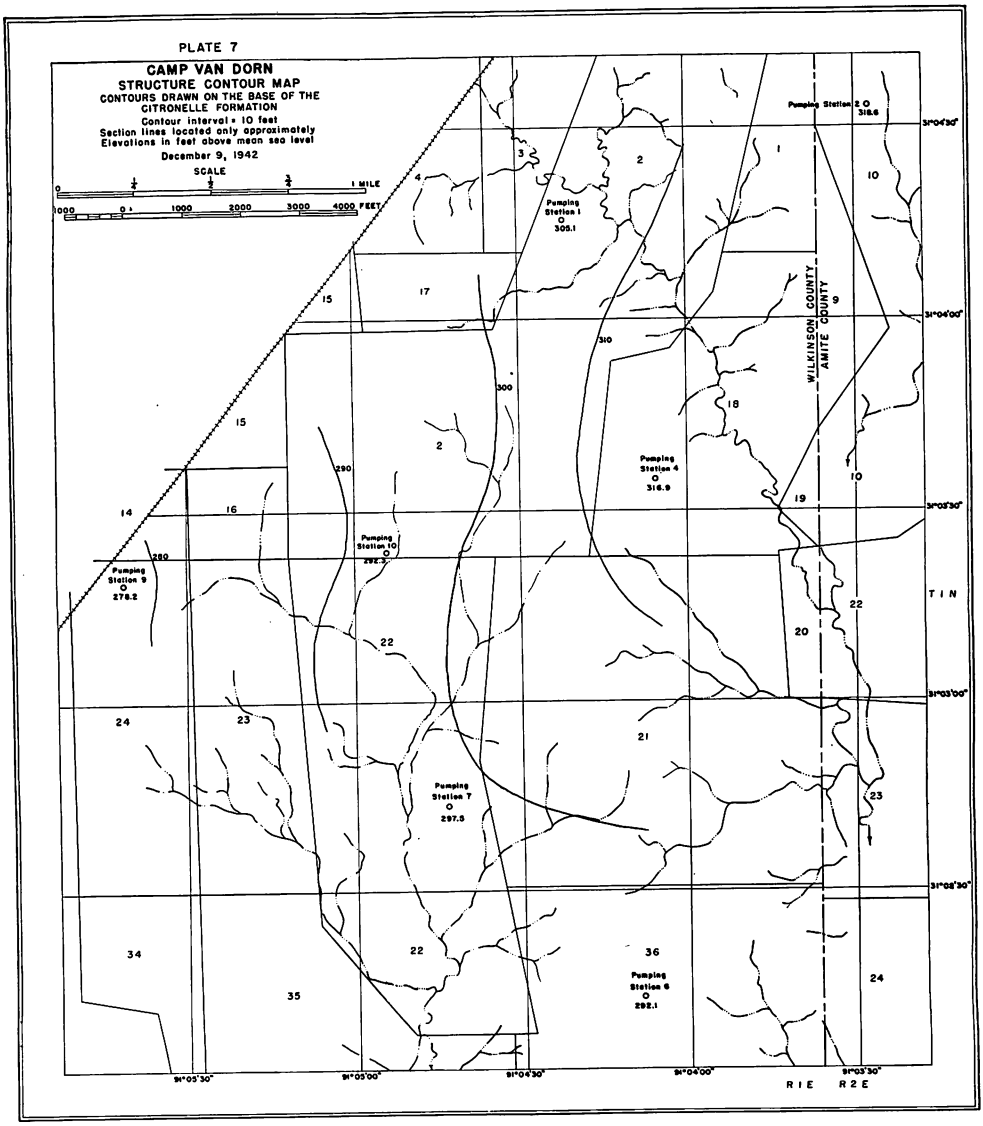


PLATE 7
CAMP VAN DORN
STRUCTURE CONTOUR MAP
CONTOURS DRAWN ON THE BASE OF THE
CITRONELLE FORMATION
Contour interval = 10 feet
Section lines located only approximately
Elevations in feet above mean sea level
December 9, 1942
SCALE
0 1/4 1/2 3/4 1 MILE
1000 0 1000 2000 3000 4000 FEET
Pumping Station 1
305.1
Pumping Station 2
318.6
Pumping Station 4
316.9
Pumping Station 6
292.1
Pumping Station 7
297.5
Pumping Station 9
278.2
Pumping Station 10
292.7
WILKINSON COUNTY
AMITE COUNTY
T 1 N
R 1 E
R 2 E
31°04'30"
31°04'00"
31°03'30"
31°03'00"
31°02'30"
91°05'30"
91°05'00"
91°04'30"
91°04'00"
91°03'30"

are quartz, brown chert, an amorphous mineral probably limonite, and the feldspars. Microcline and orthoclase are most common and some cloudy plagioclase of indices of refraction near albite is present, but the feldspars are all rather rare. The heavier minerals include magnetite and other black opaque minerals, limonite, zircon, staurolite, kyanite, rutile, and brown tourmaline, and unidentified species. A few grains of epidote are also present (Table 2). As the Citronelle is probably derived in part from the underlying beds and probably in part from the same hinterland, many of the heavy minerals are the same.

### HYDROLOGY OF THE CITRONELLE FORMATION

The wells existing in the area prior to camp construction produced water from the lower part of the Citronelle formation and from sand beds in the upper part of the Fort Adams member of the Pascagoula formation. These wells are small, hand operated, and produce only a few gallons per day except for two municipal wells at Gloster and two municipal wells at Centreville (Table 9)*. The wells at Gloster have a combined capacity of 500 gallons per minute, although actual production is about 90 gallons per minute, pumped intermittently. The water is reported to come from 15 feet of gravel at the base of the Citronelle formation. The principal supply at Centreville formerly came from a well 110.45 feet deep. No record of the material penetrated by this well is known. It was at first thought that the supply came from the Citronelle gravelly sand, but a study of cuttings from test well 3, pumping station 1, Camp Van Dorn, showed that the bottom of the Citronelle formation was about 89 feet beneath the surface at that point, and therefore that the Centreville supply probably was coming from sandy beds in the upper part of the Fort Adams member of the Pascagoula formation. Water is pumped from the Centreville well at 86 gallons per minute. The pre-existing wells are shown on Plate 3 and are listed in tabular form (Table 9).

Water is found only in the lower few feet of the Citronelle. As the base of the formation is exposed along the lower stream valleys where there are numerous springs and swamps, effluent seepage must be sufficient to drain most of the sand and gravel. This condition would make a large ground-water development in the Citronelle a rather hazardous undertaking, and the source would always be exposed to the danger of contamination.

* Second well was drilled after preparation of this report.

## GEOLOGIC STRUCTURE

The regional dip of the formations in southwestern Mississippi is presumably south into the Gulf Coast geosyncline. Superimposed on the geosynclinal flank are numerous local irregularities, such as a southeast dip across northwestern Wilkinson and western Franklin Counties, and a southwest dip at Camp Van Dorn. The oldest structural surface mapped, the base of the Homochitto member, shows the most relief and the youngest mapped, the base of the Citronelle formation, the least (Plates 5, 6, 7). This progressive decrease in magnitude is usual on the Gulf Coast and may be due to the fact that the younger beds have undergone fewer periods of folding, to ironing out of irregularities by deposition, or to a combination of both.

If the lower limit of fresh water in the upper Catahoula sand, as shown on electrical logs of oil prospect wells, is plotted in feet below mean sea level, a discontinuity, possibly a fault, is indicated about 3 miles north of Woodville that extends northeast in the direction of Crosby, Amite County. North of Woodville the upthrown side on the southeast seems to be about 450 feet higher than the base of the fresh water sand on the northwestern side. Farther northeast (T. 3 N., R. 1 E.), about 13 miles northwest of the camp, the displacement appears to be about 400 feet. The lenticular nature of the non-marine Catahoula sands makes positive identification of such a structure difficult, but, if a fault is present, it would interfere with recharge into the sands beneath the camp from that direction and might explain why the piezometric surface slopes from northeast to southwest across the cantonment area (Plate 11). If the structure lies between the outcrop area and the camp, as appears to be the case, it would also change the estimate of 15 miles to the outcrop belt. Thus the resultant effect on water levels at the camp during the next 3 years would be to lower them, but probably only a few feet beyond the estimates based on the assumption that the beds are not faulted.

## QUALITY OF WATER

The chemical character of ground waters produced from four sands at Camp Van Dorn is shown in tabular form (Table 8). These ground waters are all soft and low in total dissolved solids, the waters from the basal Pascagoula and Catahoula formations being of the sodium bicarbonate type. Free carbon dioxide causes corrosion; consequently, the water is aereated over coke trays which also removes much of the excess iron. The nearly neutral character of

TABLE 8

ANALYSES OF WATER FROM CAMP VAN DORN (PARTS PER MILLION EXCEPT pH)

| | Pumping Sta. 1 well 1 | Pumping Sta. 1 well 2 | Pumping Sta. 2 | Pumping Sta. 4 | Pumping Sta. 6 | Pumping Sta. 10 | Pumping Sta. 9 | Pumping Sta. 1 well 3 |
|---|---|---|---|---|---|---|---|---|
| Depth (feet) | 222.5 | 417 | 408.6 | 430 | 476 | 438 | 902 | 1699 |
| Producing horizon | Fort Adams | Homo-chitto | Homo-chitto | Homo-chitto | Homo-chitto | Homo-chitto | Basal Pasca-goula | Catahoula |
| Total dissolved solids | 46 | 66 | 76 | 107 | 92 | 81 | 152 | 163 |
| Total hardness as $CaCo_3$ | 11 | 22 | 26 | 40 | 30 | 24 | 32 | 7.8 |
| Silica ($SiO_2$) | 16 | 28 | ------ | ------ | ------ | ------ | 54 | 57 |
| Iron (Fe) | .16 | .01 | 3.6 | 4.8 | ------ | ------ | .08 | 1.7 |
| Calcium (Ca) | 2.6 | 5.2 | ------ | ------ | ------ | ------ | 8.4 | 1.8 |
| Magnesium (Mg) | 1.2 | 2.1 | ------ | ------ | ------ | ------ | 2.6 | .8 |
| Sodium (Na) | 6.2 | 5.6 | ------ | ------ | ------ | ------ | 25 | 37 |
| Potassium (K) | ------ | 2.0 | ------ | ------ | ------ | ------ | 2.5 | 1.4 |
| Carbonate ($CO_3$) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bicarbonate ($HCO_3$) | 15 | 34 | 36 | 56 | 47 | 38 | 94 | 102 |
| Sulphate ($SO_4$) | 1.2 | 2.3 | 1* | 3* | 2* | 2* | 9.4 | 9.2 |
| Chloride (Cl) | 7.5 | 4.4 | 5 | 8 | 4 | 4 | 4.5 | 3.4 |
| Fluoride (F) | ------ | .1 | .0 | .4 | .2 | .2 | .1 | .1 |
| Nitrate ($NO_3$) | 2.2 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| Phosphate ($PO_4$) | ------ | 0 | ------ | ------ | ------ | ------ | .3 | 0 |
| Free $CO_2$ (determined at well) | 65 | 46 | 55 | 42 | 58 | 41 | ------ | 36 |
| pH (determined at well) | 5.2 | 5.6 | 5.8 | 6.2 | 6.2 | 6.0 | 6.9 | 6.6 |
| Date of collection, 1943 | Feb. 2 | Feb. 5 | Feb. 9 | Feb. 10 | Feb. 8 | Feb. 10 | Feb. 6 | Feb. 8 |

Determination made by E. W. Lohr and Margaret S. Berry, U. S. Geological Survey, except free $CO_2$ and pH determinations which were made at the well by Mississippi State Board of Health or area engineer.

* Determined by turbidity method.

water from the basal Pascagoula sand, together with its low iron, suggests that water from pumping station 9 has a beneficial effect on the quality of water from other wells, and therefore that it should be used as much as possible.

## ACKNOWLEDGMENTS

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## GEOLOGIC LOGS OF BORINGS IN CAMP VAN DORN AREA

### A. G. Jacobs 6 Miles East of Bunckley *

Franklin County 5 — Driller:

Altitude:

| Citronelle formation (chiefly) | Thick. feet | Depth feet |
|---|---|---|
| Clay, red and yellow | 31 | 31 |
| Clay | 30 | 61 |
| Clay and sand; interstratified in layers 6 to 10 ins. thick | 20 | 81 |
| Sand; abundantly water-bearing | 10 | 91 |

### A. A. Mosher, Garden City *

Franklin County 7 — Driller:

Altitude:

| | Thick. feet | Depth feet |
|---|---|---|
| Clay | 8 | 8 |
| Sand, red and white | 15 | 23 |
| Sand, white; water-bearing | 1 | 24 |
| Clay, blue | 14 | 38 |

### T. F. Randall 5 Miles North of Bewelcome *

Amite County 11 — Driller:

Altitude:

| Citronelle formation | Thick. feet | Depth feet |
|---|---|---|
| Clay and sand, mixed | 52 | 52 |
| Quicksand; with small pebbles at base; water-bearing | 53 | 105 |

### J. N. McDowell, Coles *

Amite County 16 — Driller:

Altitude:

| Citronelle formation | Thick. feet | Depth feet |
|---|---|---|
| Clay | 4 | 4 |
| Gravel | 12 | 16 |
| Sand and gravel | 44 | 60 |
| Clay, blue; well stopped on water-bearing gravel | 20 | 80 |

### C. C. C. Camp, Gloster

Amite County 17 — Driller: C. M. Journey

Altitude: 398 feet

| | Thick. feet | Depth feet |
|---|---|---|
| Clay, sandy | 5 | 5 |
| Citronelle formation | | |
| Sand and gravel | 14 | 19 |
| Gravel and sand | 19 | 38 |

* U. S. Geological Survey, Water-Supply Paper 576, pp. 167, 78, 77.

| | | |
|---|---|---|
| Fort Adams member, Pascagoula formation | | |
| Sand | 3 | 41 |
| Sandstone, soft | 16 | 57 |
| Sandstone | 4 | 61 |
| Homochitto member (?), Pascagoula formation | | |
| Clay | 19 | 80 |
| Rock | 1 | 81 |
| Clay | 1 | 82 |
| Sand | 4 | 86 |
| Rock | 1 | 87 |
| Clay | 2 | 89 |
| Rock | 1 | 90 |
| Clay | 2 | 92 |
| Sand | 6 | 98 |
| Sandstone, soft | 14 | 112 |
| Sandstone, soft, and clay | 8 | 120 |
| Clay, lower part hard | 29 | 149 |
| Clay, hard and sandy | 23 | 172 |
| Sand | 48 | 220 |
| Gravel | 10 | 230 |
| Sand | 10 | 240 |
| Lower part (?), Pascagoula formation | | |
| Undescribed | 10 | 250 |
| Silt | 10 | 260 |
| Gumbo | 10 | 270 |
| Sand, fine | 9 | 279 |
| Sand and gravel | 15 | 294 |
| Sand, fine | 18 | 312 |
| Sand, coarse | 3 | 315 |
| Sand, water-bearing | 47 | 362 |
| Gumbo | 39 | 401 |
| Sand | 2 | 403 |
| Sand, hard | 22 | 425 |
| Sand | 51 | 476 |

### Town of Woodville

Wilkinson County 37 — Driller: W. Sperry

Altitude: 405 feet

| | Thick. feet | Depth feet |
|---|---|---|
| Citronelle formation | | |
| "Alluvial washings" (sand and clay) | 15 | 15 |
| Clay, yellow | 15 | 30 |
| Sand, white; water-bearing | 5 | 35 |
| Clay, red | 1 | 36 |
| Pascagoula formation | | |
| Clay, bluish-white | 150 | 186 |
| Clay, blue; mixed with pebbles and cobbles | 204 | 390 |
| Sand and clay; water-bearing (yields 40 gallons a minute) | 30 | 420 |

| | | |
|---|---|---|
| Clay, blue; with pebbles | 10 | 430 |
| Soapstone, blue; full of grit | 185 | 615 |
| Undescribed | 345 | 960 |

PUMPING STATION 2, CAMP VAN DORN

Wilkinson County 39 — Driller: Layne Central Co.
Altitude: 364.6 feet

| | Thick. feet | Depth feet |
|---|---|---|
| Clay | 10 | 10 |
| Citronelle formation | | |
| Sand and gravel | 36 | 46 |
| Fort Adams member, Pascagoula formation | | |
| Sand | 17 | 63 |
| Sand and thin strata of clay | 164 | 227 |
| Homochitto member, Pascagoula formation | | |
| Clay | 63 | 290 |
| Clay, sandy | 20 | 310 |
| Sand | 50 | 360 |
| Sand, coarse | 48.5 | 408.5 |

PUMPING STATION 1, WELL 1, CAMP VAN DORN

Wilkinson County 40 — Driller: Layne Central Co.
Altitude: 353.5 feet

| | Thick. feet | Depth feet |
|---|---|---|
| Top soil, clayey | 5 | 5 |
| Citronelle formation | | |
| Sand and gravel | 81 | 86 |
| Fort Adams member, Pascagoula formation | | |
| Clay | 8 | 94 |
| Clay and thin strata of sand | 10 | 104 |
| Sand, fine, and thin strata of clay | 31 | 135 |
| Clay | 1 | 136 |
| Sand, fine, and flakes of clay | 19 | 155 |
| Clay | 1 | 156 |
| Sand, medium | 17 | 173 |
| Sand, medium coarse quartz | 48 | 221 |
| Homochitto member, Pascagoula formation | | |
| Clay | 2 | 223 |

PUMPING STATION 1, WELL 2, CAMP VAN DORN

Wilkinson County 41 — Driller: Layne Central Co.
Altitude: 355.1 feet

| | Thick. feet | Depth feet |
|---|---|---|
| Top soil | 15 | 15 |
| Citronelle formation | | |
| Sand and gravel | 35 | 50 |

| | | |
|---|---|---|
| Fort Adams member, Pascagoula formation | | |
| Clay, sandy | 29 | 79 |
| Clay | 17 | 96 |
| Sand, fine | 67 | 163 |
| Clay | 2 | 165 |
| Sand, fine | 20 | 185 |
| Sand | 41 | 226 |
| Homochitto member, Pascagoula formation | | |
| Clay and thin strata of sand | 108 | 334 |
| Sand | 83 | 417 |
| Lower part, Pascagoula formation | | |
| Clay | ----- | ----- |

PUMPING STATION 1, WELL 3, CAMP VAN DORN

Wilkinson County 42 Driller: Layne Central Co.

Altitude: 356.4 feet

| | Thick. feet | Depth feet |
|---|---|---|
| Loam, brown; a few pebbles of chert | 3 | 3 |
| Citronelle formation | | |
| *Gravel, sand,* and minor yellow *clay.* Maximum dimension in sample, 40 mm. The grains and pebbles are composed of sub-angular chert and sub-rounded quartz; quartz predominates in the sand. The chert fragments contain Paleozoic fossils | 17 | 20 |
| *Sand* and *very coarse sand,* similar to above. The low mud pressure and the thin mud used probably prevented removal of coarser material most likely present | 25 | 45 |
| *Sand* and *gravel,* as above | 36 | 81 |
| Fort Adams member, Pascagoula formation | | |
| *Clay,* light green-gray somewhat waxy; non-calcareous; free of sand grains | 19 | 100 |
| *Sand,* mostly angular quartz | 17 | 117 |
| *Clay,* light green-gray somewhat waxy | 1 | 118 |
| *Sand,* angular quartz; increasing in grain size towards the base. Flakes of light green-gray clay are probably from small clay pockets or lenses in the sand; one shows on the electrical log at 130 feet; some mica | 42 | 160 |
| *Clay,* light-gray; possibly a pocket or lens | 2 | 162 |
| *Sand,* medium-rounded to sub-angular; a few scattered flakes of light green-gray non-calcareous clay | 65 | 227 |
| Homochitto member, Pascagoula formation | | |
| *Clay;* light blue-green in upper part. The lower 20 feet are gray somewhat silty non-calcareous; the contact with the underlying sand is gradational | 122 | 349 |
| *Sand;* medium at top; *very coarse sand* at base. Nearly all clear sub-rounded quartz grains; minor angular brown chert, non-calcareous | 70 | 419 |

Lower part, Pascagoula formation

| | | |
|---|---|---|
| *Shale;* blue-green and brown in streaks; and light-gray silty shale; non-calcareous | 42 | 461 |
| *Shale;* blue, green, and brown in streaks; thin layers of fine angular quartz sand; non-calcareous | 5 | 466 |
| *Shale* and thin layers of fine *sand.* The shale is blue-green and light green and brown; the sand is mostly fine angular quartz. Light-gray fragments are calcareous. Drilled hard at base | 23 | 489 |
| *Sand,* fine, or brittle *shale.* Drilled rapidly | 2 | 491 |
| *Shale,* olive-green slightly calcareous; flakes of hard white siltstone. Fragments of magafossils. Drilled very hard | 18 | 509 |
| *Shale* and *sandy shale,* green-gray and brown; non-calcareous. | 25 | 534 |
| *Shale,* as above; drilled rapidly | 2 | 536 |
| *Shale* and *sandy shale.* The shale is green-brown in the upper half and brown in the lower half. The sandy shale is light gray. Both are calcareous, the sandy shale more so | 36 | 572 |
| *Shale,* green-brown and gray; thin layers of fine angular sand; calcareous | 4 | 576 |
| *Shale,* gray and brown; calcareous | 6 | 582 |
| *Shale,* gray and brown; thin layers of fine angular quartz sand or sandy shale; calcareous | 4 | 586 |
| *Shale* and *sandy shale,* gray, green, and brown; calcareous | 34 | 620 |
| *Shale, sandy shale,* and thin layers of fine angular quartz *sand* and *siltstone;* a few small grains of glauconite are in the quartz siltstone; calcareous. Drilled slowly | 52 | 672 |
| *Sand,* fine angular quartz; drilled rapidly | 2 | 674 |
| *Shale* and *sandy shale;* thin layers of fine angular quartz *sand* and *siltstone.* The shale and sandy shale are gray, green, and dull brown; drilled slowly; calcareous | 40 | 714 |
| *Sand,* fine angular quartz; slightly cemented with calcareous material. A few grains of glauconite | 8 | 722 |
| *Shale, sandy shale,* thin layers of light-gray *siltstone,* and fine angular quartz *sand.* The shale is green and gray and calcareous | 21 | 743 |
| *Sand,* fine angular quartz | 3 | 746 |
| *Shale,* gray and green; thin layers of light-gray siltstone; calcareous. Drilled slowly | 24 | 770 |
| *Sand,* fine angular quartz; some calcareous cement | 1 | 771 |
| *Shale,* green and gray; thin layers of fine angular *sand* | 10 | 781 |
| *Sand,* fine angular quartz; slightly calcareous; a few grains of opaque minerals | 16 | 797 |
| *Sandy shale,* green and gray, slightly calcareous | 2 | 799 |
| *Sand,* fine angular quartz; a few grains of opaque minerals; slightly calcareous | 1 | 800 |
| *Sandy shale,* green and gray; slightly calcareous | 3 | 803 |
| *Sand,* fine angular quartz; a few grains of opaque minerals; slightly calcareous | 2 | 805 |

| | | |
|---|---|---|
| *Sandy shale,* green and gray; slightly calcareous | 1 | 806 |
| *Sand,* fine to medium quartz; angular to well rounded; a few grains of an opaque mineral. A few thin layers of green and gray calcareous *shale* and *sandy shale* are mostly in the upper 40 feet. The medium sand is at the base. Contact with underlying shale is somewhat gradational | 79 | 885 |
| Hattiesburg formation | | |
| *Shale* and *sandy shale.* The shale is waxy brown, blue-green, and light gray. The sandy shale is light gray; calcareous | 13 | 898 |
| *Sand,* fine angular quartz; a few grains of pyrite. Behavior of the drill suggests that thin layers of shale are in the sand | 10 | 908 |
| *Shale* and *sandy shale,* green, light-gray, and brown | 14 | 922 |
| *Sand,* fine angular quartz; a few grains of pyrite. Behavior of the drill suggests that layers of shale and sandy shale are interbedded in the sand | 14 | 936 |
| *Shale* and *sandy shale;* the cuttings include light-green calcareous siltstone and fragments of light-gray nearly white limestone. The sandy shale is gray-green with imbedded angular grains of quartz. The lower part is dark-green tough shale which breaks into small flakes | 86 | 1022 |
| *Sand,* nearly pure angular quartz; very little increase in grain size from top to bottom. Grains are 0.25 mm. average diameter; non-calcareous | 54 | 1076 |
| *Shale* and *sandy shale,* gray-green and light-gray; calcareous | 12 | 1088 |
| *Sand,* fine angular quartz; minor pyrite; thin layers of blue-green shale; slightly calcareous | 8 | 1096 |
| *Shale,* blue-green and gray; calcareous | 18 | 1114 |
| *Sand,* fine angular quartz; streaks of shale or sandy shale | 8 | 1122 |
| *Sandy shale,* light gray-green and light-gray calcareous. Drills similar to sand but the pressure on the circulating fluid rose slightly when bit was placed on the bottom of the hole | 26 | 1148 |
| *Sand,* fine angular quartz; thin streaks of shale or sandy shale | 12 | 1160 |
| *Sand,* fine angular quartz, nearly pure; very minor pyrite; mica; grain size increases slightly downward. Both top and bottom contacts are sharp | 90 | 1250 |
| *Shale* and *sandy shale,* blue-gray and light-gray; some light-gray calcareous fragments | 28 | 1278 |
| *Sand* and *sandy shale,* very fine angular quartz; some silt. Two opaque minerals in minor quantities | 14 | 1292 |
| *Shale* and *sandy shale,* gray, brown, and blue-green; some light-gray siltstone. Drilled slowly; slightly calcareous | 153 | 1445 |
| Catahoula sandstone | | |
| *Sand,* fine to medium angular quartz; very minor pyrite and white mica | 77 | 1522 |
| *Shale* or *sandy shale;* no cuttings | 9 | 1531 |
| *Sand,* fine to medium angular quartz; very minor pyrite and white mica | 61 | 1592 |

| | | |
|---|---|---|
| *Shale;* no cuttings | 11 | 1603 |
| *Sand,* medium to very coarse; angular to sub-rounded *clay* and cloudy quartz; coarse material is near the middle. The very coarse sand is composed of rounded frosted quartz, brown (contamination?) and dark-gray chert, some angular, some rounded. The appearance is similar to the very coarse sand at 419 feet and may be contamination | 92 | 1695 |

Note: The samples in the two lower sands are of questionable value as the pump failed to pump complete returns. Lime was added to the mud and the resulting sample from the hole at 1,592 feet was coarser than the earlier samples, suggesting that the mud pressure was insufficient to remove the coarser fraction of the sand from the well.

### Pumping Station 4, Camp Van Dorn

Wilkinson County 44 — Driller: Layne Central Co.
Altitude: 356.9 feet

| | Thick. feet | Depth feet |
|---|---|---|
| Top soil | 10 | 10 |
| Citronelle formation | | |
| Sand and gravel | 30 | 40 |
| Fort Adams member, Pascagoula formation | | |
| Sand and thin strata of soft clay | 53 | 93 |
| Clay | 10 | 103 |
| Sand and thin strata of clay | 137 | 240 |
| Homochitto member, Pascagoula formation | | |
| Clay, hard | 59 | 299 |
| Sand | 1 | 300 |
| Clay, hard | 32 | 332 |
| Sand and thin strata of clay | 24 | 356 |
| Sand, coarse | 74 | 430 |

### Pumping Station 10, Camp Van Dorn

Wilkinson County 45 — Driller: Layne Central Co.
Altitude: 354.0 feet

| | Thick. feet | Depth feet |
|---|---|---|
| Citronelle formation | | |
| Sand | 28 | 28 |
| Sand and gravel | 34 | 62 |
| Fort Adams member, Pascagoula formation | | |
| Sand | 19 | 81 |
| Clay and sand | 87 | 168 |
| Clay | 8 | 176 |
| Clay and sand | 78 | 254 |
| Homochitto member, Pascagoula formation | | |
| Clay | 12 | 266 |
| Sand and thin strata of clay | 28 | 294 |

| | | |
|---|---|---|
| Clay, hard | 31 | 325 |
| Shale | 24 | 349 |
| Sand and shale | 20 | 369 |
| Sand | 66 | 435 |
| Clay | 3 | 438 |

PUMPING STATION 9, CAMP VAN DORN

Wilkinson County 46 Driller: Layne Central Co.

Altitude: 383.2 feet

| | Thick. feet | Depth feet |
|---|---|---|
| Top soil | 10 | 10 |
| Citronelle formation | | |
| Sand and gravel | 15 | 25 |
| Sand and thin strata of clay | 70 | 95 |
| Gravel | 10 | 105 |
| Fort Adams member, Pascagoula formation | | |
| Sand and thin strata of clay | 105 | 210 |
| Clay | 30 | 240 |
| Shale | 70 | 310 |
| Gravel | 10 | 320 |
| Homochitto member, Pascagoula formation | | |
| Sand and shale | 40 | 360 |
| Sand | 5 | 365 |
| Shale | 5 | 370 |
| Sand | 8 | 378 |
| Shale, hard | 62 | 440 |
| Sand and clay | 18 | 458 |
| Sand | 12 | 470 |
| Shale | 2 | 472 |
| Sand | 13 | 485 |
| Lower part, Pascagoula formation | | |
| Clay, tough | 45 | 530 |
| Shale, hard | 80 | 610 |
| Shale and thin strata of sand | 160 | 770 |
| Sand | 5 | 775 |
| Clay | 3 | 778 |
| Shale and thin strata of sand | 12 | 790 |
| Sand | 35 | 825 |
| Shale | 2 | 827 |
| Sand | 20 | 847 |
| Hattiesburg formation | | |
| Shale and thin strata of sand | 55 | 902 |

### Pumping Station 7, Camp Van Dorn

Wilkinson County 51 — Driller: Layne Central Co.
Altitude: 332.5 feet

| | Thick. feet | Depth feet |
|---|---|---|
| Top soil | 15 | 15 |
| Citronelle formation | | |
| Gravel | 10 | 25 |
| Fort Adams member, Pascagoula formation | | |
| Sand and thin strata of clay | 32 | 57 |
| Clay | 27 | 84 |
| Rock | 1 | 85 |
| Sand | 53 | 138 |
| Clay | 2 | 140 |
| Sand | 18 | 158 |
| Clay | 27 | 185 |
| Sand and thin strata of clay | 39 | 224 |
| Homochitto member, Pascagoula formation | | |
| Clay, tough | 89 | 313 |
| Sand | 8 | 321 |
| Clay | 9 | 330 |
| Clay, tough | 14 | 344 |
| Sand | 12 | 356 |
| Clay | 16 | 372 |
| Sand | 104 | 476 |

### Pumping Station 6 Well 1, Camp Van Dorn

Wilkinson County 53 — Driller: Layne Central Co.
Altitude: 337.1 feet

| | Thick. feet | Depth feet |
|---|---|---|
| Clay | 15 | 15 |
| Citronelle formation | | |
| Sand and gravel | 30 | 45 |
| Fort Adams member, Pascagoula formation | | |
| Sand; streaks of clay | 25 | 70 |
| Clay; streaks of sand | 25 | 95 |
| Rock | 1 | 96 |
| Clay; streaks of sand | 34 | 130 |
| Sand; streaks of clay | 150 | 280 |
| Homochitto member, Pascagoula formation | | |
| Clay | 17 | 297 |
| Sand | 31 | 328 |
| Clay | 58 | 386 |
| Sand | 90 | 476 |

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TABLE 9

BORINGS IN THE CAMP VAN DORN AREA

| No. | Location | Owner or name | Driller | Type of well | Date completed | Diameter of well (inches) | Depth of well (feet) | Depth to which well is cased (feet) | Depth to top of screen or perf. pipe (feet) | Length of screen or perf. pipe (feet) | Principal water-bearing bed: Thickness (feet) | Principal water-bearing bed: Character of material | Principal water-bearing bed: Geologic horizon | Ground altitude above sea level (feet) | Water level: Depth below land surface (feet) | Water level: Above mean sea level (feet) | Use of water | Electric log interval | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **FRANKLIN COUNTY** | | | | | | | | | | |
| 1. | 600 feet N., 200 feet E. of SW. Cor., SE. 1/4, SW. 1/4, Sec. 31, T. 6 N., R. 2 E. | Homochitto Lbr. Co. No. 1 | Fred E. Courson et al | Oil prospect | 1935 | 10 | 4024 | 475 | | | | | | 380 | | | Abandoned | | |
| 2. | SW. 1/4, Sec. 34, T. 6 N., R. 2 E | H. D. Hunt | | Water | | 14 | 114 | | | | | Gravel | Citronelle | | | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 168. |
| 3. | SE. 1/4, Sec. 43, T. 6 N., R. 1 E. | C. E. McMillan | | Water | | 12 | 53 | | | | | Sand | Citronelle | | | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 168. |
| 4. | 150 feet N., 50 feet W. of Cen. Sec. 18, T. 5 N., R. 3 E. | Homochitto Lbr. Co. No. 2 | Texas Gulf Production Co. | Oil Prospect | 1937 | 10 | 5009 | 492 | | | | | | 324 | | | Abandoned | 492–5009 | |
| 5. | NE. 1/4, Sec. 33 (?), T. 5 N., R. 3 E. | A. G. Jacobs | | Water | | 10 | 91 | | | | | Sand | Citronelle | | | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 167. |
| 6. | SE. 1/4, NW. 1/4, Sec. 29, T. 5 N., R. 2 E. | T. E. Edwards | | Water | | 12 | 80 | | | | 15 | White quick sand | Fort Adams | | | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 167. |
| 7. | SE. 1/4, Sec. 41, T. 5 N., R. 1 E. | A. A. Mosher | | Water | | | 38 | | | | 1 | White sand | Homochitto | | | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 167. |
| | | | | | | | | | **AMITE COUNTY** | | | | | | | | | | |
| 8. | NE. 1/4, Sec. 7, T. 4 N., R. 3 E. | H. McAlister | | Water | 1913 | 10 | 130 | | | | 4 | Gravel | Citronelle | | –126 | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 9. | SE. 1/4, Sec. 12, T. 4 N., R. 3 E. | W. L. Jacobs | | Water | 1911 | 10 | 70 | | | | 10 | Gravel | Citronelle | | –60 | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 10. | 1/2 mile NW. of O'Neil, Sec. (?), T. 4. N., R. 3 E. | W. J. Steele | | Water | | | 74 | | | | | Sand and gravel | Citronelle | | | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 11. | NE. 1/4, NW. 1/4, Sec. 34, T. 4 N., R. 3 E. | T. F. Randall | | Water | 1905 | 6 | 105 | | | | 52 | Quick sand pebbly at base | Citronelle | | –52 | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 12. | 461 feet E., 150 feet N. of SW. Cor., SW. 1/4, SW. 1/4, Sec. 29, T. 4 N., R. 2 E. | Southern Forest Land Company No. 1 | North Texas Oil Company | Oil prospect | 1937 | 10 | 5217 | 840 | | | | | | 345 | | | Abandoned | 840–5217 | |
| 13. | NW. 1/4, Sec. 30, T. 4 N., R. 2 E. | Robert Wilson | | Water | 1902 | 18 | 90± | | | | | Sand | Citronelle | | –82 | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 14. | SW. 1/4, Sec. 30, T. 4 N. R. 2 E. | A. J. McDowell | | Water | 1898 | 18 | 52 | | | | | Sand and gravel | Citronelle | | –50 | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 15. | SE. 1/4, Sec. 32, T. 4 N., R. 2 E. | Natalbany Lbr. Co. | | Water | 1909 | 12 | 136 | | | | 2 | Gravel | Fort Adams | | –134 | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 16. | SW. 1/4, Sec. 32, T. 4 N., R. 2 E. | J. N. McDowell | | Water | 1900 | 12 | 80 | | | | | Sand & gravel | Citronelle | | –62 | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 17. | NE. 1/4, Sec. 4, T. 3 N., R. 2 E. | C. C. C. Camp | C. M. Journey | Water | 1934 | 3 | 476 | 476 | (202<br>(461 | (40<br>(20 | | Sand & gravel<br>Sand | Fort Adams<br>Homochitto | 398 (bar.) | 175 | 223 | Domestic | | |
| 18. | NE. 1/4, Sec. 23, T. 3 N., R. 2 E. | Town of Gloster | | Water | 1901 | 18 | 100 | | | | | Sand and some gravel | Citronelle | | –57 | | Reserve supply | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 19. | Gloster, 1/2 block W. of Y. & M. V. R. R. Station, Sec. 34, T. 3 N., R. 2 E. | Town of Gloster | | Water | 1918 | 18 | 80 | | | 15 | | Gravel | Citronelle | | –65 | | Municipal | | Pumped 275 g.p.m., intermittently. From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 20. | Gloster, 1/2 block W. of Y. & M. V. R. R. Station, Sec. 34, T. 3 N., R. 2 E. | Town of Gloster | | Water | 1928 | 5 | 80 | | | 8 | | Gravel | Citronelle | | –65 | | Municipal | | Pumped 225 g.p.m., intermittently. |
| 21. | SW. 1/4, SW. 1/4, Sec. 32, T. 2 N., R. 2 E. | L. M. Gallent | | Water | 1908 | 2 | 130 | | | | 5 | Sand | Citronelle | | –50 | | Boiler probably abandoned | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 22. | Street, 1/8 mile E. of P. O., Sec. 20, T. 1 N., R. 3 E. | C. N. Street | | Water | 1907 | 10 | 44 | | | | 4 | | Citronelle | | –40 | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 23. | Olio, Sec. 25, T. 1 N., R. 3 E. | R. D. Smith | | Water | 1890 | 6 | 40 | | | | 5 | Gravel | Citronelle | | –30 | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 24. | Sec. 12, T. 1 N., R. 3 E. | T. P. Simpson | | Water | 1898 | 6 | 45 | | | | 5 | Gravel | Citronelle | | –40 | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 79. |
| 25. | SE 1/4, NE. 1/4, Sec. 32, T. 1 N., R. 2 E. | J. S. Miller | J. N. Dunn | Water | 1938 | 8 | 92 | 92 | 92 | | | White sand | Citronelle | | –84 | | Domestic | | |
| 26. | NE. 1/4, SW. 1/4, Sec. 27, T. 1 N., R. 2 E. | Sara Johnson | | Water | | | 75 | | | | | Sand | Citronelle | | | | Domestic | | |
| 27. | SW. 1/4, NW. 1/4, Sec. 39, T. 1 N., R. 2 E. | R. N. Callendar | | Water | 1939 | 6 | 80 | | | | | White sand | Citronelle | | –70 | | Domestic | | |
| 28. | SE. 1/4, SW. 1/4, Sec. 38, T. 1 N., R. 2 E. | P. Q. Pierce | | Water | 1941 | 8 | 36 | | | | 4 | White sand | Citronelle | | –32 | | Domestic | | |
| | | | | | | | | | **WILKINSON COUNTY** | | | | | | | | | | |
| 29. | 350 feet E. and N. SW. Cor., Sec. 15, T. 4 N., R. 2 W. | Young and Crosby No. 1 | Bering Oil Company, Inc. | Oil prospect | 1941 | 8¾ | 6793 | 1087 | | | | | | 370 | | | Abandoned | 1087–6793 | |
| 30. | 330 feet E., 330 feet S. NW. Cor., SW. 1/4 SW. 1/4, Sec. 34, T. 4 N., R. 1 W. | Miss.-Wis. Timber & Land Co. No. 1 | A. B. Taylor et al | Oil prospect | 1937 | 9⅞ | 5279 | 666 | | | | | | 254 | | | Abandoned | 666–5279 | |
| 31. | 50 feet W., 210 feet N., SE. Cor., SW. 1/4 SW. 1/4, Sec. 35, T. 4 N., R. 1 W. | Miss.-Wis. Timber & Land Co. No. 2 | Louisiana Crusader | Oil prospect | 1939 | 6¼ | 3617 | 469 | | | | | | 198 | | | Abandoned | 469–3617 | |
| 32. | NW. Cor., Sec. 32, T. 4 N., R. 2 W. | Foster Creek Lbr. Co. No. 1 | A. B. Taylor | Oil prospect | 1937 | 9⅞ | 3815 | 713 | | | | | | | | | Abandoned | 713–3815 | |
| 33. | 792 feet 88° NW. 1/4, SE. Cor., Sec. 40, T. 4 N., R. 1 E. | A. M. Young No. 1 | Louisiana Progress | Oil prospect | 1939 | 9⅞ | 5748 | 1228 | | | | | | 350 | | | Abandoned | 1228–5748 | |
| 34. | Cen. SW. 1/4, SW. 1/4, Sec. 10, T. 3 N., R. 1 E. | Crosby L. & M. Co. No. 1 | Bering Oil Company, Inc. | Oil prospect | 1942 | 10¾ | 7504 | 1091 | | | | | | 408 | | | | 1091–7504 | |
| 35. | Cen. SE. 1/4, Sec. 8, T. 3 N., R. 1 E. | Foster Creek Lumber No. 1 | Charles Green et al | Oil prospect | 1936 | | 5048 | | | | | | | 413 | | | | 3000–5048 | |
| 36. | 300 feet E., 75 feet S., NW. Cor., Sec. 32, T. 4 N., R. 2 W. | Foster Creek Lumber No. 1 | H. L. Carnahan | Oil prospect | 1937 | 10 | 5007 | 1500 | | | | | | 226 | | | | 1500–5007 | |
| 37. | Woodville, 1/4 mile S. of P. O. | Town of Woodville | W. Sperry | Water | | 8 | 960 | | | | | | | 450 | –300 | 105 | Municipal | | |
| 38. | SW. 1/4, SE. 1/4, Sec. 38, T. 2 N., R. 1 E. | Town of Centreville | | Water | 1931 | 8 | 110.45 | 110.45 | 100± | 24 | 53 | White sand and gravel | Fort Adams | 378.6 | –54.1 | 324.5 | Municipal | | Pumped intermittently at 89 gallons per minute. |
| 39. | Pumping Station 2, Camp Van Dorn, 50 feet W., 240 feet N. intersection E. Hospital and N. Hospital Roads. | U. S. Army | Layne Central Compnay | Water | 1942 | 12 & 8 | 408.6 | 404.8 | 340.7 | 60.17 | 98.5 | | Homochitto | 364.6 | –134.05 | 230.55 | Army | | |
| 40. | Well 1, Pumping Station 1, Camp Van Dorn, 585 feet E., 290 feet S., intersection 4th and 15th Avenues | U. S. Army | Layne Central Company | Water | 1942 | 16 | 222.5 | 225.99 | 161.83 | 60.17 | 65 | Medium and coarse sand | Fort Adams | 353.5 | | | Army | | |
| 41. | Well 2, Pumping Station 1, Camp Van Dorn, 540 feet E., 320 feet S. intersection 4th and 15th Avenues | U. S. Army | Layne Central Company | Water | 1942 | 12 | 417 | 421.0 | 354.67 | 60.33 | 83 | Sand | Homochitto | 355.1 | –45.5 | 309.6 | Army | | |
| 42. | Well 3, Pumping Station 1, Camp Van Dorn, 500 feet E., 340 feet S., intersection 4th and 15th Avenues | U. S. Army | Layne Central Company | Water | 1942 | 12 | 1698.66 | 1689.0 | 1624.7 | 60.17 | 95 | Sand | Catahoula | 356.4 | –238.1 | 118.3 | Army | | |
| 43. | Sec. 2, T. 1 N., R. 1 E. | U. S. Army | H. Trask | Water | 1941 | 8 | 47 | | | | | White sand | Citronelle | | –35 | | Abandoned | | |
| 44. | Pumping Station 4, Camp Van Dorn, 300 feet E., 100 feet S. intersection 12th Street and 15th Avenue | U. S. Army | Layne Central Company | Water | 1942 | 12 | 430 | 427.5 | 363.42 | 60.58 | 74 | Coarse sand | Homochitto | 356.9 | –139.32 | 217.58 | | | |
| 45. | Pumping Station 10, Camp Van Dorn, 75 feet E., 320 feet S. intersection 11th Street and 8th Avenue | U. S. Army | Layne Central Company | Water | 1942 | 12 (?) | 438 | 433.84 | 372.09 | 60.00 | 66 | Sand | Homochitto | 354.0 | –132.07 | 221.93 | Army | | |
| 46. | Pumping Station 9, Camp Van Dorn, 290 feet W., 270 feet N. intersection 1st Avenue and 18th Street | U. S. Army | Layne Central Company | Water | 1942 | 12 (?) | 902 | 840.42 | 778.5 | 60.17 | 25 | Sand | Basal Pascagoula | 383.2 | –224.87 | 158.33 | Army | | |
| 47. | Sec. 2, T. 1 N., R. 1 E. | U. S. Army | Collin Veal | Water | 1938 | | 75 | | | | | White sand | Citronelle | | –59 | | Abandoned | | |
| 48. | Sec. 21, T. 1 N., R. 1 E. | U. S. Army | Collin Veal | Water | 1938 | | 65 | | | | | | Citronelle | | –57 | | Abandoned | | |
| 49. | SW. 1/4, Sec. 21, T. 1 N., R. 1 E. | U. S. Army | Collin Veal | Water | 1941 | 8 | 56 | | | | | White sand | Citronelle | | –50 | | Abandoned | | |
| 50. | Sec. 22, T. 1 N., R. 1 E. | U. S. Army | T. Netterville | Water | 1941 | | 55 | | | | | | Citronelle | | –50 | | Abandoned | | |
| 51. | Pumping Station 7, Camp Van Dorn, 420 feet S., 50 feet W. intersection 13th Avenue and 21st Street | U. S. Army | Layne Central Company | Water | 1942 | 12 | 476 | 460 | 396 | 60.5 | 104.0 | Sand | Homochitto | 332.5 | –107.7 | 224.8 | Army | | |
| 52. | SW. 1/4, Sec. 21, T. 1 N., R. 1 E. | U. S. Army | Collin Veal | Water | 1938 | 8 | 60 | | | | | Red sand | Citronelle | | | | Abandoned | | |
| 53. | Pumping Station 6, Camp Van Dorn, 230 feet S. intersection 17th Avenue and 25th Street | U. S. Army | Layne Central Company | Water | 1942 | 12 (?) | 476 | 474.17 | 411.99 | 60.43 | 90.0 | Sand | Homochitto | 337.10 | –116.05 | 221.05 | Army | | |
| 54. | SE. 1/4, SE. 1/4, Sec. 35, T. 1 N., R. 1 E. | U. S. Army | | Water | 1938 | 8 | 55 | | | | | White sand | Citronelle | | –59 | | Abandoned | | |
| 55. | SW. 1/4, Sec 36, T. 1 N., R. 1 E. | U. S. Army | | Water | | | | | | | | | Citronelle | | –40 | | Abandoned | | From U. S. Geological Survey Water-Supply Paper 576, p. 490. |
| 56. | Newtonia | A. E. Morgan | | Water | | | 63 | | | | | White sand | Citronelle | | | | Domestic | | |
| 57. | 2 miles NE. Turnbull | Jesse Carter | | Water | | | 89 | | | | | Sand and gravel | Citronelle | | | | Domestic | | From U. S. Geological Survey Water-Supply Paper 576, p. 490. |
| 58. | 392 feet SW. 1/4, SW. Cor. Sec. 22, T. 1 N., R. 2 W. | W. A. Lanehart No. 1 | Kirby Petroleum Company | Oil prospect | 1936 | 16 & 10 | 5508 | 585 | | | | | | | | | Abandoned | 585–4680 | |