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PRELIMINARY REPORT ON COMPLETION OF THE NEW MEXICO STATE ENGINEER DEMING TEST WELL

By

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INTRODUCTION

In order to obtain information as to whether sufficient water for irrigation purposes occurs in strata below those from which water is now being obtained, a test well was drilled 3½ miles southwest of Deming, N. Mex. This well is located on the W. G. Gordon farm in the NW corner of the SW¼ SE¼ Sec. 6, T. 24 S., R. 9 W. Funds for the drilling of this well were contributed by the New Mexico State Engineer, the United States Geological Survey, the Bureau of Agricultural Economics, and by residents of the Deming area. The drilling contract was awarded to Wininger Brothers of Safford, Arizona, who used a Bucyrus-Armstrong cable-tool rig in drilling the well.

Drilling began on March 16, 1941, and drilling and testing were completed on May 23, 1941. The strata drilled consisted for the most part of unconsolidated or partially consolidated sand, gravel, and clay; but the lower part of the well was drilled through consolidated igneous rock.

The deeper irrigation wells of the Deming area reach depths of approximately 300 feet. Unperforated 12½-inch O. D. lap-welded oil-well casing was run to this depth, and a cement plug was formed around the bottom of this casing so as to shut out water from aquifers encountered above this depth, from the well. Eight-inch I. D. lap-welded oil-well casing was then run to a depth of 653 feet, and at this depth it was necessary to change to 6-inch pipe as the pressure of the strata against the 8-inch pipe prevented its being driven deeper. In general very little open hole could be drilled before it was necessary to lower the casing to prevent caving of the penetrated strata. It was necessary to drive the 12½-inch pipe, and the 8-inch pipe was spudded (alternately lifted and allowed to fall) to lower it. The 6-inch pipe was run to only 730 feet, and the well was completed to 1,000 feet in open hole. As the 1,000-foot mark was approached, material again started caving from the uncased portion of the hole. As no aquifers of importance were encountered below the 8-inch pipe, the 6-inch pipe was removed from the hole. A bailing test of the uncased portion of the well yielded 23.2 gallons a minute with a drawdown of 100 feet. Most of this water probably flowed down into the well from behind the 8-inch casing.

From an examination of the samples of well cuttings and the amount of water encountered by the drill, it was apparent that most of the water was confined to the upper 442 feet of the well. The 8-inch casing was therefore perforated between 303 and 442 feet with a Mills knife. The well was then developed and tested to determine its yield and the hydrologic properties of the aquifers encountered. (See pumping test below.)

Field chloride and hardness tests were run on the water yielded during the pumping of the well and on several samples obtained from the bailer at depths less than 300 feet. There appears to be little difference in the chemical character of the water at different depths. The shallower water contained 18 parts chloride per million and 95 parts hardness per million, whereas the water pumped from below 300 feet contained 10 parts chloride and 95 parts hardness according to the field tests.

Samples of the material penetrated by the drill were collected from the bailer at each change of material or at each 10-foot interval. In general, samples of clay, sandy clay, and volcanic ash were sacked without washing. Where sand, gravel, and rhyolite were penetrated, part of the sample was usually washed so as to show more clearly the nature of the larger particles contained in the sample. A driller's log and a sample log based on a study of these cuttings follow:

DRILLER'S LOG OF NEW MEXICO STATE ENGINEER DEMING TEST WELL

Depth (ft.)	*Material*
0-10	Soil with sand streaks and caliche
10-16	Clay, sand and caliche
16-20	Gray sand and gravel, some clay
20-30	Clay with some sand
30-35	Sand and clay
35-50	Gravel and sand
50-53	Gravel and sand with a show of clay
53-60	Gravel and sand
60-80	Clay (adobe)
80-83	Clay with a show of caliche
83-88	Clay and caliche, first show of water at 88 feet
88-95	Sand, gravel and clay
95-102	Sand (water)
102-106	Gravel and sand (more water)
106-110	Gravel and sand with some clay (water)
110-112	Clay
112-118	Clean gravel (pea-sized) good show of water
118-122	Clay and sand
122-145	Clay and sand and some gravel
145-150	Clay
150-163	Sand with clay (some water)

163-190	Sand and clay
190-205	Clay
205-207	Gravel and sand (water)
207-215	Clay, sand and gravel (show of caliche at 207 feet)
215-225	Sand and clay
225-227	Gravel and sand and show of white sticky clay (water)
227-234	Sand and clay
234-235	Coarse gravel (water)
235-245	Sand (water), hole caving badly
245-247	Sand gravel, and clay
247-263	Sand and clay
263-273	Sand (water)
273-283	Sand, fine gravel, and clay
283-293	Sand with clay breaks
293-303	Clay and sand[1]
303-306	Gravel (water), casing perforated with 6 holes per lineal foot after drilling was completed
306-328	Clay, sandy
328-333	Sand and gravel, casing perforated as above
333-337	Sand, casing perforated as above
337-347	Clay and sand
347-361	Sand, casing perforated as above
361-370	Clay (hole failed to stand without casing, 8-inch pipe started)
370-380	Sand, rose in casing when struck, coarser at 372 feet
380-390	Sand, medium-to-coarse with some clay, perforated with 4 holes per lineal foot
390-400	Fine sand with clay, casing perforated with 6 holes per lineal foot from 390-440 feet
400-410	Sand, clay, and show of gravel
410-413	Sand and clay
413-417	Gravel, drilled slowly as if cemented
417-419	Clay
419-430	Sand and gravel (water)
430-433	Sand, gravel, and clay
433-437	Clay
437-440	Sand and gravel (hole caving)
440-442	Sand and gravel (hole caving), perforated with 4 holes per lineal foot

1 Ten sacks of cement were placed in the hole when it was at a depth of 297 feet. Top of the cement in the casing was held at 292 feet under the weight of the drill stem and tools. Bottom of the 12½-inch casing was at 292.5 feet. The cement plug was drilled through after reducing to an 8-inch bit.

The top of the 8-inch pipe is at 290 feet below the surface; the upper 290 feet of the casing was removed from the hole after parting the pipe with a collar buster. The coupling on top of the 8-inch pipe is thought to be loose on the pipe, because of the difficulty experienced in lowering the bailer into the 8-inch pipe.

442-444	Clay
444-449	Clay and sand
449-452	Clay
452-453	Clay, hole caving, pipe at 445 feet
453-458	Clay
458-467	Sand and clay, too fine for water
467-470	Clay
470-475	Sand, somewhat consolidated
475-500	Clay, sandy
500-525	Clay
525-530	Clay with a 1-foot coarse sand break
530-541	Clay with sand streaks
541-568	Red sandy clay
568-570	Coarse sand and gravel
570-584	Red sandy clay
584-586	Coarse sand and clay, hard drilling
586-592	Clay, some sand (hard drilling)
592-595	Sand and clay, hard drilling, sand probably caving from above
595-600	Coarse sand and clay, hard drilling
600-618	Clay, some sand, better drilling
618-620	Clay, little sand, harder drilling
620-624	Sandy clay, harder drilling
624-629	Brown clay, some sand, bailed out 200 feet of water
629-631	Sand and clay, little water, bailed out 200 feet of water. Water had recovered from previous bailing
631-638	Coarse sand and clay (unassorted), some water
638-644	Yellow clay
644-650	Clay
650-655	Clay, little sand (bottom of 8-inch casing at 653 feet)
655-661	Reddish clay, little sand
661-668	Clay, ending in sand
668-673	Sandy clay
673-679	Clay
679-698	Sand with clay, hard drilling
698-711	Clay, perhaps altered volcanic ash
711-718	Sand and clay, hole caving some
718-725	Clay, perhaps altered volcanic ash[2]
725-745	Dark gray clay or shale

2 Eight-inch pipe was spudded to 653 feet, after which the hole was drilled ahead to 725 feet and then underreamed to that depth for 8-inch pipe. However, side pressure on the 8-inch pipe prevented driving it, and it was therefore necessary to run 6-inch pipe instead. The 6-inch pipe was carried to 732 feet and the hole completed from that depth to 1,000 feet without additional casing. Clay began caving into the hole as a depth of 1,000 feet was approached.

745-760	Gray clay with fine sand and silt
760-765	Gray clay, lighter color
765-770	Dark gray clay or shale with red to lavender clay, strong bog-like odor, scum on water, gas bubbles
770-775	Red sandstone, appears too tight for water
775-785	Red sandstone and dark gray clay
785-795	Light gray clay or shale
795-805	Light gray clay with streaks of red sandy sticky clay
805-808	Hard red sandstone
808-815	Red sandstone and gray shale
815-818	Red sandstone
818-822	Pink clay
822-835	Red sandstone or agglomerate, chips of a fine-grained igneous rock resembling a mica dacite in the cuttings
835-837	Gray clay
837-842	Red sandstone
842-845	Gray clay
845-901	Volcanic ash (??) cuttings appear to go into suspension and did not settle from the water in the bailer in sufficient quantity to afford a sample; the rock penetrated was sharp and abrasive and cut the bit rapidly
901-998	Porphyritic rhyolite (red)
998-1001	Volcanic ash (light gray)[3]

3 All 6-inch pipe removed from the hole on its completion.

SAMPLE LOG OF NEW MEXICO STATE ENGINEER DEMING TEST WELL

Samples of well cuttings (numbers 1-107, inclusive) were collected at intervals of 10 feet or fractions thereof where a change in formation occurred during the drilling of the well. The samples were first examined with the aid of a hand lens. This examination was supplemented by microscopic examination of samples selected at intervals between depths of 0 and 711 feet, but all samples were examined beginning with number 82 (711-718 feet) as the conditions under which the material below this depth was deposited appeared more diverse than during deposition of the overlying material.

Samples examined microscopically are indicated by the * mark in the following log:

Depth (feet)	*Number*	*Material*	*Description*
0-10	1	Soil (clay), sand and caliche	Clay constitutes nearly all of sample, but sand and caliche form a small part of the sample.
10-20	2	Clay, sand, gravel, and caliche	Mostly clay, small amount of sand, a few angular pebbles, and some caliche.
20-30	3	Clay and sand	Clay forms about 80 per cent of sample and sand grains the remainder.
30-40	4	Clay, sand, and gravel	Three constituents in about equal proportions. Pebbles of dark, fine-grained, gray, igneous rock range up to 1 inch in greatest dimension. Pebbles commonly tabular (lens shaped).
40-50	5	Gravel, sand, and clay	Igneous rock pebbles form about 50 per cent of sample, ranging from 1 inch in greatest dimension down to very coarse sand grains. Sand forms 30 per cent of sample, and clay forms remaining 20 per cent.
50-60	6	Gravel, sand, and clay	Constituents in about equal proportions. Pebbles of dense gray and red igneous rock are commonly less than ½ inch in greatest dimension.

Depth (feet)	*Number*	*Material*	*Description*
60-70	*7	Clay	Consists chiefly of flesh-pink translucent clay fragments in minute flakes. Unlike most other samples, does not effervesce with HCl. Contains a few colorless, crystal-clear grains of sanidine feldspar and a few small grains of volcanic rocks.
70-80	8	Clay	Mostly clay but some caliche.
80-90	9	Clay	Mostly clay but some caliche.
90-100	10	Sand, gravel, and clay	Sand appears to form about half the sample, gravel and clay form the remainder in about equal proportions.
100-102	11	Sand and clay	Medium-to-fine grained sand with about 30 per cent clay.
102-110	12	Gravel, sand, and clay	Dense dark gray pebbles of igneous rock form about 45 per cent of sample, sand grains form about 35 per cent, and the remaining 20 per cent is clay.
110-118	*13	Gravel	Rather well rounded pebbles of dense gray igneous rock ranging from ½ inch down to about ⅛ inch form 50 per cent of the sample. Fragments approximately ⅛ inch in diameter form another 30 per cent of the sample. The remaining 20 per cent is formed by finer sand and a small amount of clay. Sanidine crystals form about 5 per cent of sample and range in size from 1/64 inch to 1/16 inch across. A few flakes of black biotite mica are present. Sample, like practically all samples from well, effervesces with acid. This effervescence is not caused by visible particles of lime but by extremely fine limy cement.
118-130	14	Clay, sand, and gravel	About 50 per cent of sample is usual pink clay, 30 per cent is fine,

Depth (feet)	*Number*	*Material*	*Description*
			medium, and coarse sand, and 20 per cent is gravel.
130-140	15	Clay	Sample is largely clay with about 15 per cent sand and a few small pebbles.
140-150	16	Clay	Sample is mainly clay with some sand and a few small pebbles.
150-155	17	Sand, clay, and gravel	About 50 per cent of sample is coarse-to-fine sand, 25 per cent clay, and 25 per cent fine gravel.
155-163	18	Sand, clay, and gravel	About 60 per cent of sample is medium-grained sand, 20 per cent is clay, and 20 per cent fine gravel.
163-173	19	Sand, clay, and gravel	About 60 per cent of sample is sand, about 25 per cent clay, and 15 per cent fine gravel.
173-183	*20 (washed)	Sand, clay, and gravel	Grains in washed samples range in size from fine sand to fine gravel. Larger grains are well-rounded. About 70 per cent of washed sample consists of rounded fragments of igneous rocks mostly gray in color although some are flesh-pink or green. Rhyolite fragments show sanidine and biotite phenocrysts. Some fragments of dense-to-glassy rock are present. About 20 per cent of sample consists of grains of clear colorless sanidine and some biotite flakes. Unwashed sample consists of about 60 per cent fine-to-coarse sand, 20 per cent clay, and 20 per cent very fine gravel.
183-195	21	Clay	Samples about 80 per cent clay and 20 per cent sand and fine gravel.
195-205	*22	Clay, sand, and gravel	Sample about 50 per cent clay, 35 per cent sand, and 15 per cent fine gravel. Limy cement effervesces with HCl. Particles present are largely clear colorless sanidine crystals and pink, dark gray, and light gray particles of igneous rocks.

Depth (feet)	*Number*	*Material*	*Description*
205-207	23	Gravel, sand, and clay	Three constituents are in about equal proportions. Most of pebbles are dark gray fine-grained igneous rock and are generally lens shaped.
207-215	24	Clay, sand, and gravel	Clay forms about 40 per cent of sample, sand 35 per cent, and very fine gravel 25 per cent.
215-225	25	Clay and sand	Sample is about 70 per cent clay, 20 per cent fine sand, and 10 per cent fine gravel.
225-227	*26	Gravel with sand and clay	Approximately 70 per cent of sample consists of pebbles of dense igneous rocks, which may attain 1 inch in greatest dimension, 30 per cent of clay flakes and sand. Sanidine and biotite are abundant in the sandy portion of the sample. HCl causes effervescence of a few grains, probably caliche.
227-234	27	Clay and sand Sand	Clay forms about 55 per cent of the sample and fine sand about 40 per cent. The remaining 5 per cent is fine gravel. Much of clay may be caving from above.
234-245	28	Sand	Medium-grained sand forms about 80 per cent of the sample. Clay and fine gravel each form about 10 per cent.
245-255	29	Sand and clay	Fine sand forms about 60 per cent of the sample, clay 35 per cent, and fine gravel the remainder.
255-263	30	Sand	Most of sample composed of a very fine sand with some clay. Fine gravel forms about 5 per cent of the sample.
263-273	31	Sand	Fine-to-medium grained sand forms about 90 per cent of the sample. Clay and fine gravel forms remainder.
273-283	*32 (washed)	Sand, clay and gravel	Nearly 70 per cent of washed sample consists of grains of dense red-

Depth (feet)	*Number*	*Material*	*Description*
			dish igneous rocks. About 25 per cent of sample consists of feldspar, largely clear colorless sanidine showing some crystal faces, but in smaller amount oligoclase showing occasional albite twinning and occurring in flatter plates and showing better cleavage, and more pronounced corrosion and fracturing than the sanidine. In unwashed sample, sand forms about 50 per cent of sample, clay 30 per cent, and very fine gravel 20 per cent.
283-293	33	Sand	Medium-to-fine grained sand forms about 70 per cent of sample. Clay and gravel each form about 15 per cent.
293-303	34	Sand, gravel and clay	Sand forms about 50 per cent of the sample with gravel and clay each forming about 25 per cent of the sample. Sample has a slightly more pronounced red color than previous samples and red pebbles are becoming more numerous in the gravel.
303-306	*35 (washed)	Gravel	Pebbles ranging in size from ¼ inch to more than 1 inch are largely dense dark gray or reddish igneous rock fragments—andesites, etc. Sanidine is abundant as separate grains and as phenocrysts along with biotite and hornblende in rock fragments. Sand grains form about 15 per cent of the sample.
306-315	36	Clay	Sample is reddish silty clay.
315-328	37	Clay	Sample is light brown silty clay with a few small gravel pebbles.
328-337	38	Sand	Medium-to-fine grained sand forms about 75 per cent of the sample, 15 per cent is very fine-grained sand, and 10 per cent clay.

Depth (feet)	*Number*	*Material*	*Description*
337-347	39	Clay and sand	Sample is a mixture of about equal parts sand and clay with about 10 per cent very fine gravel.
347-357	*40 (washed)	Sand	Some particles approach ¼ inch in greatest dimension. About 60 per cent of washed sample consists of rounded fragments of dense igneous rocks. Sanidine is present in large grains, 1/16 inch. Tabular oligoclase crystals slightly larger than the sanidine ones are present. In unwashed samples, medium-grained sand forms about 85 per cent of the sample with the remainder being formed by clay and fine gravel.
357-370	41	Sand	Medium-grained sand forms about 80 per cent of the sample with the remainder being formed by clay and fine gravel.
370-380	42	Sand	Medium - to - coarse grained sand with a few small pebbles. Sand pink to reddish colored.
380-390	43	Sand	Medium-to-fine grained sand with perhaps 30 per cent clay.
390-400	44	Sand	Poorly sorted sand with about 25 per cent clay.
400-410	45	Sand	Sand forms about 75 per cent of the sample, clay about 20 per cent, and fine gravel about 5 per cent.
410-413	46	Sand	Fine sand with about 20 per cent clay and 10 per cent pebbles averaging about ⅛ inch in diameter.
413-420	47	Gravel	About 60 per cent of the sample is fine gravel, and the remainder is sand with a very small amount of clay. Pebbles are largely dark gray dense igneous rock and are subangular in form.
420-430	*48 (washed)	Sand and gravel	Fragments, largely of fine-grained rounded andesitic material and

Depth (feet)	*Number*	*Material*	*Description*
			rhyolitic material showing feldspar and hornblende phenocrysts, form about 70 per cent of the washed sample and clear colorless sanidine with subordinate oligoclase constitutes about 30 per cent. In the unwashed sample, unsorted sand forms about 75 per cent of the sample, and the remainder is fine gravel.
430-440	49	Sand	Unsorted sand forms about 75 per cent of the sample and the remainder is formed by pebbles approximating ⅛ inch in diameter.
440-450	50	Sand and clay	About 70 per cent of the sample is sand and 30 per cent clay. Sample is usual light pinkish brown color. Sanidine feldspar grains are quite prominent.
450-460	51	Sand and clay	Sand and clay in about equal proportions form the sample.
460-470	52	Sand and clay	Fine sand and clay occur in about equal amounts. About 5 per cent of sample is a fine gravel. Sample is light reddish brown in color.
470-480	53	Sand and clay	Fine sand forms about 80 per cent of sample and clay forms the remainder.
480-490	54	Sandy clay	Clay forms about 70 per cent of sample and sand 30 per cent.
490-500	55	Sandy clay	Clay forms about 60 per cent of sample and unsorted sand 40 per cent.
500-510	56	Sandy clay	Clay forms about 60 per cent of sample and sand 40 per cent.
510-520	57	Sandy clay	Clay forms about 70 per cent of sample and remainder is unsorted sand.
520-530	*58	Clay	Clay forms about 50 per cent of the sample and unsorted sand the

Depth (feet)	Number	Material	Description
			remainder. Crystals of sanidine, fragments of rhyolitic rock containing hornblende, and fragments of other dense igneous rocks form the coarser particles. Very little rounding is shown by granular material.

Depth (feet)	Number	Material	Description
530-540	59	Sandy clay	Clay forms about 60 per cent of the sample and fairly coarse sand forms about 40 per cent.
540-550	60	Sandy clay	Clay forms about 70 per cent of the sample and sand about 30 per cent.
550-560	61	Sandy clay	Clay with about 15 per cent of coarse sand grains.
560-568	62	Sandy clay	Clay with about 25 per cent of coarse sand to fine gravel.
568-570	63	Fine gravel	Rather well sorted fine gravel. Most of pebbles are smaller than ¼ inch in diameter. Most fragments are angular.
570-580	64	Sandy clay	Sample consists of clay and unsorted angular sand in about equal proportions.
580-584	65	Sandy clay	Clay forms about 70 per cent of the sample and sand 30 per cent.
584-586	66	Coarse sand and clay	Coarse angular sand grains form about 50 per cent of the sample and clay the remainder.
586-595	67	Clay	Sample largely clay with about 15 per cent of sand.
595-600	*68	Sand and clay	Sand grains form about 50 per cent of the sample with remainder being composed of flesh-pink clay flakes. Considerable sanidine, fragments of a gray fine-grained igneous rock with quartz and biotite phenocrysts (resembling a mica

Depth (feet)	*Number*	*Material*	*Description*
			dacite), and some pink rhyolitic rock fragments form the coarser material.
600-610	69	Clay	Clay forms practically all of sample.
610-620	70	Clay	Sample consists of clay and few sand grains.
620-630	71	Sandy clay	Clay forms about 80 per cent of the sample and angular sand grains the remainder.
630-640	72	Sand	Sample consists of about 40 per cent coarse sand grains, 20 per cent clay, and 40 per cent fine sand grains.
640-650	73	Clay	Light brown clay forms practically all of the sample.
650-660	74	Clay	Sample consists of buff-colored clay.
660-670	75	Sandy clay	Red clay forms about 70 per cent of the sample and coarse angular sand grains 30 per cent.
670-680	76	Clay	Sample consists of light gray and red clay.
680-685	77	Sand	Sample consists of about 80 per cent coarse angular well sorted sand grains and about 20 per cent clay.
685-692	78	Sand	Sample consists of about 70 per cent medium grained angular sand grains and 30 per cent clay. Grains are largely composed of a gray dense apparently acidic igneous rock, some colorless, crystal clear sanidine, and some pink rhyolitic rock fragments. Very little rounding apparent on any grains.
692-698	79	Sand	Sample consists of about 80 per cent medium grained angular sand grains and 20 per cent clay. Sand

Depth (feet)	Number	Material	Description
			grains are gray in color and clay is pink.
698-706	80	Clay	Sample consists of fine gray clay which becomes very hard on drying, somewhat ashy.
706-711	81	Clay	Gray clay, somewhat ashy.
711-718	82	Sand and clay	Medium-grained angular sand grains form about 65 per cent of the sample and flesh-pink clay flakes about 35 per cent. Biotite flakes are abundant. Particles consist largely of a light gray dense igneous rock with subordinate rhyolitic material, also numerous sanidine grains and a few magnetite crystals. Lime in cement effervesces with acid.
718-725	83	Clay	Largely fine flakey clay material. Coarser fragments are scarce and consist of usual materials—sanidine gray dense igneous rock particles, pink rhyolitic rock fragments, and biotite. HCl produces an effervescence of short duration on fine materials.
725-735	*84	Dark gray clay	Very little effervescence with HCl. Material difficult to wet, soaks up acid slowly. Flesh pink clay flakes form the major portion of the sample. Coarser fragments are sanidine, gray dense igneous rock particles, pink rhyolitic rock fragments, and biotite. Reason for change from pink color of number 83 to dark gray color for 84 not apparent under microscope as material wetted with acid has same pink color as previous samples. Biotite appears to be a trifle more abundant.
735-745	*85	Dark gray clay	Largely flesh-pink clay flakes. Moderate effervescence of sample with acid. Biotite mica fairly abun-

Depth (feet)	Number	Material	Description
			dant. Larger fragments consist of colorless sanidine and of gray and pink fine-grained igneous rocks. Fragments do not show rounding.
745-755	*86	Gray clay	Largely made up of pink clay flakes. Coarse fragments rare and consist of gray dense igneous rock fragments and biotite flakes. Some of powdery materials effervesce with acid.
755-765	*87	Gray clay	Largely the usual clay flakes. Sanidine, biotite, and pink rhyolitic rock fragments form most of the coarser material. A few grains of magnetite are present. Acid produces effervescence confined to material in powdered part of sample.
765-775	*88 (washed)	Red sand and gray clay	Pink rhyolitic rock in somewhat rounded fragments forms about 60 per cent of the washed sample. Remainder of the sample is formed by feldspar, largely clear colorless grains of sanidine containing some inclusions and very similar appearing oligoclase which has occasional albite twinning, and is more tabular, shows better cleavage, and more extensive fracturing and corrosion than the sanidine. Some grains of magnetite are present. Unwashed sample effervesces with acid and shows about 50 per cent clay.
775-785	*89	Gray clay and red sand	Clay flakes form about 70 per cent of sample. Remaining 30 per cent formed by rhyolitic rock fragments, sanidine and oligoclase crystals, and a few grains of magnetite.
785-795	*90	Light gray clay	Mostly clay. Pink rhyolitic rock fragments, gray dense igneous rock particles, and biotite form most of

Depth (feet)	Number	Material	Description
			the coarser materials. Effervesces with acid.
795-805	*91	Light gray clay and silty clay	Sample consists largely of clay; sanidine, biotite, and usual igneous rock fragments are present in limited amounts.
805-815	*92	Gray clay	Sample composed largely of clay flakes. A few particles of igneous rock, flakes of biotite, and grains of sanidine are present.
815-825	*93	Clay with red sand	Largely flesh-pink clay flakes. Coarser material consists largely of fragments of igneous rocks. Particles all angular. Some of powder effervesces with acid.
825-835	*94	Red sand	Most of washed material is a medium-grained sand, but some fragments exceeding one-quarter inch in diameter occur. Colorless clear sanidine crystals and black biotite flakes are abundant. Somewhat rounded fragments of light gray dense igneous rock, pink rhyolitic rock and dense-to-glassy igneous rock are also present.
835-845	*95	Gray clay	Largely clay, coarser material consists of fragments of dense igneous rocks, sanidine biotite, and oligoclase.
845-901	Special sample	Material which settled from water bailed during drilling from 845-901 feet. Ash (?)	Material very fine-grained, about consistency of flour. Pink-to-tan colored. About 75 per cent of sample is a clouded glassy material containing numerous minute phenocrysts. In addition to the glassy material grains of quartz, biotite, magnetite, fluorite, and plagioclase occur. Fragments of a red dense igneous rock are also present. Exact designation of sample is difficult because of paucity and fineness of the sample. Its abrasive character and the fact that the ma-

Depth (feet)	*Number*	*Material*	*Description*
			terial became suspended in the drilling water indicates an ash-like nature for the rock penetrated. Proportion of non-glassy material is probably higher in sample than in strata penetrated because of difficulty of settling the material from suspension.
901-998	*96-106	Rhyolite or trachyte	Samples 96 to 106 are quite similar although cuttings become somewhat coarser with depth, varying in size from that of a fine sand to a medium-grained sand. Grains of dense flesh-pink, rhyolitic rock form nearly 70 per cent of the samples. Quartz in small quantity occurs as minute crystals associated with the ground-mass of the rhyolite. Sanidine, about 30 per cent of the sample, is the most common single mineral, biotite flakes are also common but apparently not so abundant as in samples from 90 to 95. Oligoclase also is not so apparent. Magnetite grains are common. Samples indicate a quartz-poor rhyolite or perhaps a trachyte.
998-1000	107	Altered volcanic ash	Sample of poor quality because material caving from uncased portion of hole, particularly from 725-845 feet, could not be washed from sample without also washing away cuttings of material from 998-1000 feet. Material formed a sticky clay-like mass which adhered to the bit. Distinguishable minerals in the sample are sanidine, plagioclase, and biotite. Much flesh-colored clay material is present in sample and has probably caved from above. Glassy material containing many minute crystals is abundant as are also rhyolitic rock fragments. The ash appears to have

Depth (feet)	*Number*	*Material*	*Description*
			undergone alteration processes similar to those producing bentonite.

The strata penetrated by the well begins with Quaternary alluvium at the top probably underlain by alluvial material of Tertiary age. The contact if present could not be distinguished in the well log. The material from 845 feet to the bottom of the hole at 1001 feet consists of volcanic ash and rhyolitic flows probably of Tertiary age. All the sediments were apparently derived from igneous rocks. The material near the surface has been fairly well rounded, indicating that it has been transported farther than that at lower depths, which is more angular and consists largely of particles apparently derived from the immediately underlying igneous rocks.

WATER-LEVEL MEASUREMENTS

Water level measurements were made during the drilling of the well by means of a steel tape. They have all been reduced to a common datum, the land surface at the well site. The reference point used for making most of these measurements was a filed notch in the top edge of the 12½ inch casing on the northwest side. This point is 0.70 foot above the land surface datum. The measurements were divided for tabulation purposes into morning measurements, taken after the water level in the well had had time to recover from the previous day's operations, and evening readings, taken immediately after the day's drilling. It was found that there was a progressive rise of the water level from approximately 74 feet when the well was 88 feet deep to less than 55 feet when the well was 541 feet deep. The water-level measurements are presented in the following table:

MORNING WATER-LEVEL MEASUREMENTS, DEMING TEST WELL

Water level, in feet below land surface datum, 1941

Date	Drilled from (feet)	to	Time a.m.	Inside 12½-inch casing	Inside 8-inch casing	Bottom of 12½-inch pipe at (feet)
Mar. 16	0	16				
17	16	48				
18	48	57	(hole started caving)			
19	57	88				62
20	88	118	7:30	74.39	(inflow of water first apparent when hole was 88 ft. deep)	102
21	118	195	8:00	74.54		163
22	195	215	7:30	76.70		199
23			8:00	76.25		
24	215	247	9:15	74.22		236
25	247	269	7:45	67.47		254
26	269	297	7:30	65.93		293
27	Ran cement plug from 292 to 297 feet					
30	297	311	12:00 Noon	60.88	(cement in bottom of casing)	
						Bottom of 8-inch pipe at
31	311	357	7:45	61.80		
Apr. 1	357	370	8:00	62.00		
2			8:00	60.50		370
3	370	419	7:20	58.36		378
4	419	444	7:40	56.72	66.34	
5	444	467	7:30	55.90	74.25	445
6	467	500	8:00	55.33	66.28	480
7	500	541	7:30	55.11	59.16	524
8	541	557	7:15	54.94	61.57	539
9	557	576	7:30	57.11(?)	61.79	576
10	576	595	7:30	54.82	58.99	
11	595	618	7:30	54.81	56.74	
12	618	624	7:15	54.79	56.00	
13	No measurements, no drilling—Sunday					
14	624	638	7:20	54.83	55.32	583
15[1]	638	661	7:30	54.89	55.37	
16	661	685	7:15	54.89	55.19	
17	685	698	7:30	54.91	55.10	
18	698	718	7:35	54.90	55.14	
19	718	725	7:05	54.90	55.11	
20	No measurements or work, Sunday					
21			7:15	54.88	55.70	
22			7:35	54.82	54.88	590
23			7:40	54.88	55.17	613
24			7:30	54.88	55.20	633

1 Jonas' well 113 feet north of test well started pumping at 3:00 p. m. April 14; approximately 400 gallons a minute. Stopped about noon April 25.

MORNING WATER-LEVEL MEASUREMENTS, DEMING TEST WELL

Continued

Water level, in feet below land surface datum, 1941

Date		Drilled from (feet)	to (feet)	Time a.m.	Inside 12½-in. casing	Inside 6-in. pipe	Inside 8-in. casing	Bottom of 6-inch pipe at (feet)
	25			7:25	54.84		54.90	
	26			7:30	54.74		54.68	
	27			7:15	54.94		....	653
	28			8:45	54.87		54.90	
	29			10:21	54.93		54.90	
	30			11:30	54.98		54.49	
May	1			7:20	54.98		54.88	679
	2			7:40	55.02	23.28[2]	29.34[2]	
	3	725	729	7:30	55.00	55.24	55.03	724
	4	729	745	7:25	54.93	54.94		
	5	745	762	7:15	54.93	55.03		730
	6	762	808	7:00	54.85	54.89		
	7	808	825	7:15	54.87	54.95	56.74(??)	
	8	825	852	7:30	54.84	55.14	54.79	
	9	852	892	7:00	54.83	55.13	54.79	
	10[3]	892	925	7:30	54.89	56.08	55.93	
	11	925	955	8:00	54.90	56.10	57.19	
	12	955	995	12:10	54.84	55.95	55.57	
	13[4]	995	1,001	9:45	54.85	56.90		
	14[5]			7:30	54.87	56.76		
	15[6]							
	16			7:00	54.81		54.97	

2 Abnormal readings caused by displacement of water by 6-inch pipe.

3 Two 12-hour shifts started midnight May 9.

4 Jonas' well 113 feet north of test well began pumping May 12 at 1:00 p. m.; approximately 400 gallons a minute.

5 Began removing 6-inch pipe May 13; completed removal May 14.

6 Began perforating 8-inch pipe May 15; completed perforations May 16.

EVENING WATER-LEVEL MEASUREMENTS, DEMING TEST WELL

Water level, in feet below land surface datum, 1941

Date		Time p.m.	Inside 12½-inch casing	Inside 6-inch casing	Inside 8-inch casing
Mar.	20	6:30	110.00		
	21	6:00	83.23		
	22	4:45	83.04		
	23				
	24	6:15	86.75		
	25	6:30	67.92		
	26				
	30	6:00	95.35		
	31	4:45	65.53		
Apr.	1				
	2	5:30	59.84 (No drilling on 2nd.)		
	3	6:00	57.20		75.84
	4	6:00	56.42		
	5	6:00	54.53		66.80
	6	5:30	55.50		66.87
	7	6:15	55.19		66.49
	8	6:30	55.09		77.05
	9	6:30	55.00		88.29
	10	6:45	55.05		68.44
	11	6:30	54.95		62.80
	12	2:30	54.89		56.06
	13	No measurements			
	14[1]	7:00	54.94		91.92
	15	6:45	55.07		73.04
	16	6:50	55.10		82.24
	17	7:00	55.04		75.24
	18	7:00	55.07		65.63
	19	6:20	55.01		65.65
	20	No measurements			
	21	5:20	54.80		52.59
	22	6:25	54.96		54.85
	23	6:45	54.96		66.17
	24	6:50	54.98		65.85
	25	6:05	54.89		
	26				
	27[2]	4:20	54.86		34.31
	28[2]	6:45	54.77		23.40
	29	6:40	54.93		54.45
	30	5:40	54.98		54.90
May	1[3]	4:00	55.07		00.00
	2	4:45	55.17	69.51	62.47

1 Jonas' well 113 feet north of test well began pumping April 14 at 3:00 p. m. approximately 400 gallons a minute. Stopped about noon April 25.

2 High water level resulted from water being pumped into 8-inch casing.

3 Water flowed over top of 8-inch casing when 6-inch casing was inserted.

EVENING WATER-LEVEL MEASUREMENTS, DEMING TEST WELL
Continued

Water level, in feet below land surface datum, 1941

Date		Time p.m.	Inside 12½-inch casing	Inside 6-inch casing	Inside 8-inch casing
	3	6:40	55.05	64.10	
	4	5:15	55.16	63.83	
	5	6:50	54.95	58.90	
	6	6:30	55.14	55.76	56.97
	7	6:30	55.10	56.70	58.60
May	8	6:15	54.93	59.14	58.04
	9	6:00	54.58	56.05	55.80
	10[4]	8:30	54.77	54.93	54.78
	11				
	12	8:30	54.71	55.07	
	13				
	14				
	15				
	16				

PUMPING TEST

The well was developed by pumping. The developing began at 8:30 a. m. May 20 and lasted until 2:45 a. m. May 21, a period of 18¼ hours. The water level was then allowed to recover until 7:00 p. m. May 21, a period of 16¼ hours, at which time the water stood at 56.43 feet below the land surface or still approximately 1.6 feet below the static level.

The well was pumped continuously from 7:00 p. m. May 21 to 9:00 a. m. May 22, a period of 14 hours, by which time the drawdown appeared to have reached a constant figure.

The well pumped 465 gallons a minute, drawing down the water level from 54.80 to 98.19 feet, a distance of 43.39 feet, thus indicating a specific capacity of 10.7 gallons yield per foot of drawdown.

Recovery measurements were made until 2:10 p. m. May 24, a period of 53 1/6 hours. At this time the water level was still approximately 1.64 feet below the static level.

The transmissibility of the aquifers penetrated was determined, using Theis' recovery formula[1], which may be written

$$T = \frac{264\ q}{s} \log \frac{t}{t'}$$

where T is the coefficient of transmissibility of the aquifers, that is,

4 Two 12-hour shifts started midnight May 9.

1 Theis, C. V.: The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage. Am. Geophys. Union Trans., pp. 519-524, 1935.

the number of gallons of water which will move in one day through a vertical strip of the aquifers 1 foot wide and having the height of the aquifers when the hydraulic gradient is unity; q is the discharge of the well in gallons a minute; s the residual drawdown of the water level, in feet; t is the time since the discharge started, expressed in any unit of time; and t′ is the time since the discharge stopped, in the same unit.

Substituting the values obtained by measuring the recovery of the water level in the test well gave a coefficient of transmissibility of about 21,000.

The data used for the calculations and the recovery curve (fig. 1) follows:

TABLE 1

Pumping began 7:00 p. m. May 21, 1941, and stopped 9:00 a. m. May 22

Time	Depth to water (feet)	Time since pumping started t (hours)	Time since pumping stopped t′ (hours)	$\frac{t}{t'}$
May 22				
9:02.7 a. m.	72.36	14.044	.044	351.00
9:03.3	71.72	14.055	.055	255.00
9:05.1	70.45	14.087	.087	161.90
9:06.0	69.95	14.100	.100	141.00
9:07.1	69.44	14.118	.118	119.60
9:08.3	69.00	14.138	.138	102.50
9:10.5	68.28	14.175	.175	81.00
9:12.3	67.80	14.204	.204	69.70
9:14.1	67.42	14.235	.235	60.60
9:14.8	67.29	14.246	.246	57.90
9:15.5	67.16	14.258	.258	55.30
9:16.1	67.05	14.268	.268	53.20
9:16.7	66.93	14.280	.280	51.00
9:18.1	66.70	14.301	.301	47.55
9:18.8	66.57	14.314	.314	45.60
9:19.5	66.48	14.325	.325	44.10
9:20.3	66.36	14.338	.338	42.40
9:24.0	65.87	14.400	.400	36.00
9:28.3	65.40	14.471	.471	30.73
9:30.0	65.22	14.500	.500	29.00
9:34.6	64.81	14.576	.576	25.30
9:37.3	64.58	14.621	.621	23.55
9:40.4	64.36	14.673	.673	21.80
9:42.0	64.24	14.700	.700	21.00
9:47.9	63.87	14.798	.798	18.53
9:52.0	63.63	14.866	.866	17.18
9:54.7	63.49	14.911	.911	16.38

TABLE 1—*Continued*

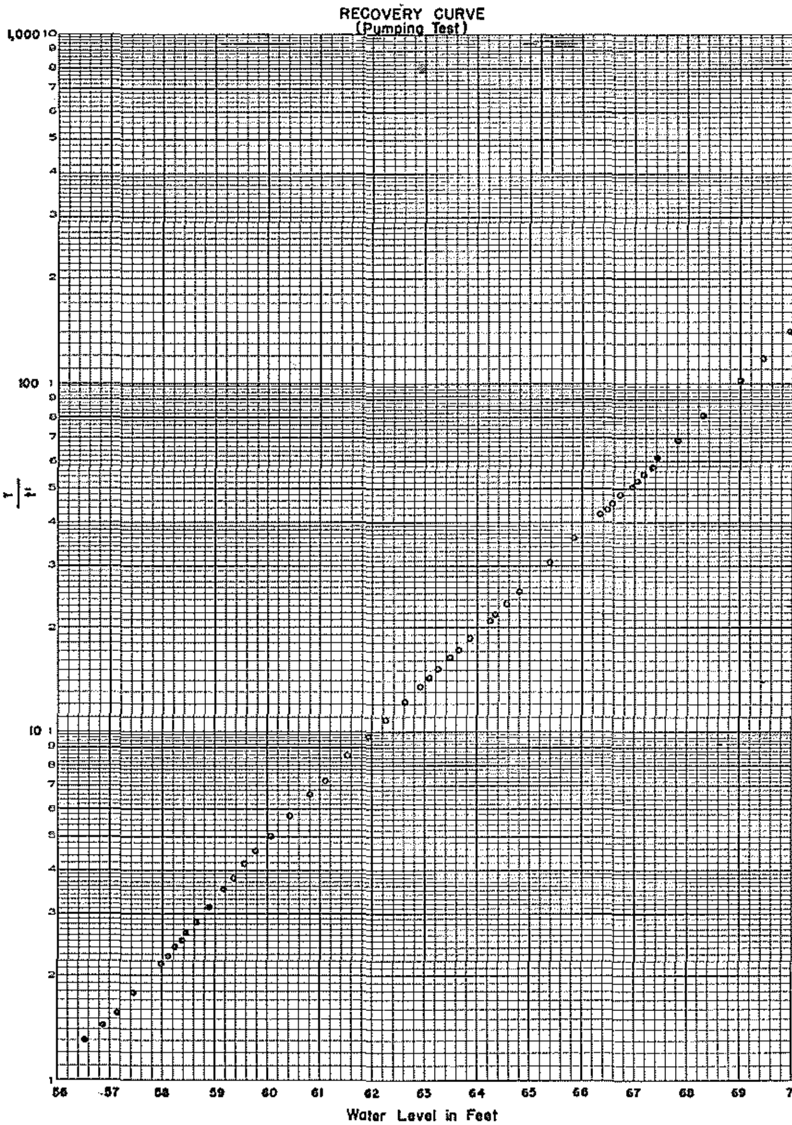
Pumping began 7:00 p. m. May 21, 1941, and stopped 9:00 a. m. May 22

Time	Depth to water (feet)	Time since pumping started t (hours)	Time since pumping stopped t′ (hours)	$\frac{t}{t'}$
May 22 contd.				
9:59.3	63.26	14.988	0.988	15.17
10:02.8	63.05	15.046	1.046	14.37
10:07.5	62.90	15.116	1.116	13.54
10:14.8	62.61	15.246	1.246	12.22
10:25.0	62.27	15.420	1.420	10.89
10:37.0	61.93	15.620	1.620	9.66
10:52	61.55	15.87	1.87	8.50
11:15	61.11	16.25	2.25	7.22
11:30	60.84	16.50	2.50	6.60
12:00 Noon	60.42	17.00	3.00	5.67
12:30 p. m.	60.08	17.50	3.50	5.00
1:00	59.79	18.00	4.00	4.50
1:30	59.55	18.50	4.50	4.11
2:00	59.35	19.00	5.00	3.80
2:30	59.18	19.50	5.50	3.55
3:30	58.86	20.50	6.50	3.15
4:30	58.63	21.50	7.50	2.87
5:30	58.43	22.50	8.50	2.65
6:00	58.34	23.00	9.00	2.55
7:00	58.20	24.00	10.00	2.40
8:00	58.08	25.00	11.00	2.27
9:00	57.98	26.00	12.00	2.17
May 23				
3:00 a. m.	57.45	32.00	18.00	1.78
10:00	57.13	39.00	25.00	1.56
4:00 p. m.	56.89	45.00	31.00	1.45
May 24				
7:00 a. m.	56.55	60.00	46.00	1.30

Substituting the value 6.9 as the horizontal intercept between the values of $t/t' = 10$ and $t/t' = 100$ in the previously stated equation gives a value for T of 18,371. If 5.8 is used as the horizontal intercept as indicated by the slope of line between values of $t/t' = 1$ and $t/t' = 10$, then T = 21,185.

Since the well was developed at a practically constant rate of 465 gallons a minute, it was possible to compute the transmissibility using

Figure 1


RECOVERY CURVE
(Pumping Test)
1,000
100
10
1
$\frac{T}{t'}$
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
Water Level in Feet

data based both on the developing and pumping test periods. The formula in this case becoming

$$T = \frac{264q}{s} \log \frac{tt_1}{t't'_1}$$

where the symbols have the same values as in the previous equation, and t_1 is the time since the developing started and t'_1 is the time since the developing stopped.

The data required in addition to that given in table 1 and the recovery curve based on these data follow:

TABLE 2

Combined developing and pumping test recovery figures. Developing began at 8:30 a. m. May 20, 1941, and stopped at 2:45 a. m. May 21. Pumping rate 465 gallons a minute. Pumping began 7:00 p. m. May 21, 1941, and stopped 9:00 a. m. May 22.

Time	Time since developing started (hours) t_1	Time since developing stopped (hours) t'_1	$\frac{tt_1}{t't'_1}$
May 22			
9:02.7 a. m.	48.544	30.294	512.3
9:03.3	48.556	30.306	409.5
9:05.1	48.585	30.335	236.0
9:06.0	48.600	30.350	225.8
9:07.1	48.618	30.368	191.5
9:08.3	48.638	30.388	164.2
9:10.5	48.675	30.425	129.5
9:12.3	48.704	30.454	111.4
9:14.1	48.734	30.484	96.8
9:14.8	48.746	30.496	92.5
9:15.5	48.757	30.507	88.3
9:16.1	48.768	30.518	85.1
9:16.7	48.778	30.528	81.5
9:18.1	48.801	30.551	76.0
9:18.8	48.814	30.564	72.9
9:19.5	48.825	30.575	70.4
9:20.3	48.838	30.588	67.70
9:24.0	48.900	30.650	57.45
9:28.3	48.971	30.721	49.00
9:30.0	49.000	30.750	46.20
9:34.6	49.076	30.826	40.25
9:37.3	49.122	30.872	37.50
9:40.4	49.173	30.923	34.63
9:42.0	49.200	30.950	33.39
9:47.9	49.298	31.048	29.43
9:52.0	49.366	31.116	27.23
9:54.7	49.412	31.162	25.98
9:59.3	49.487	31.237	24.01

Time	Time since developing started (hours) t_1	Time since developing stopped (hours) t'_1	$\frac{tt_1}{t't'_1}$
10:02.8	49.546	31.296	22.76
10:07.5	49.625	31.375	21.41
10:14.8	49.746	31.496	19.31
10:25	49.92	31.67	17.17
10:37	50.12	31.87	15.20
10:52	50.37	32.12	13.40
11:15	50.75	32.50	11.27
11:30	51.00	32.75	10.27
12:00 Noon	51.50	33.25	8.83
12:30 p. m.	52.00	33.75	7.70
1:00	52.50	34.25	7.11
1:30	.53.00	34.75	6.46
2:00	53.50	35.25	5.94
2:30	54.00	35.75	5.51
3:30	55.00	36.75	4.85
4:30	56.00	37.75	4.37
5:30	57.00	38.75	4.00
6:00	57.50	39.25	3.84
7:00	58.50	40.25	3.58
8:00	59.50	41.25	3.36
9:00	60.50	42.25	3.18
May 23			
3:00 a. m.	66.50	48.25	2.45
10:00	73.50	55.25	2.07
12:00 Noon	75.50	57.25	2.00
4:00 p. m.	79.50	61.25	1.88
May 24			
7:00 a. m.	94.50	76.25	1.62

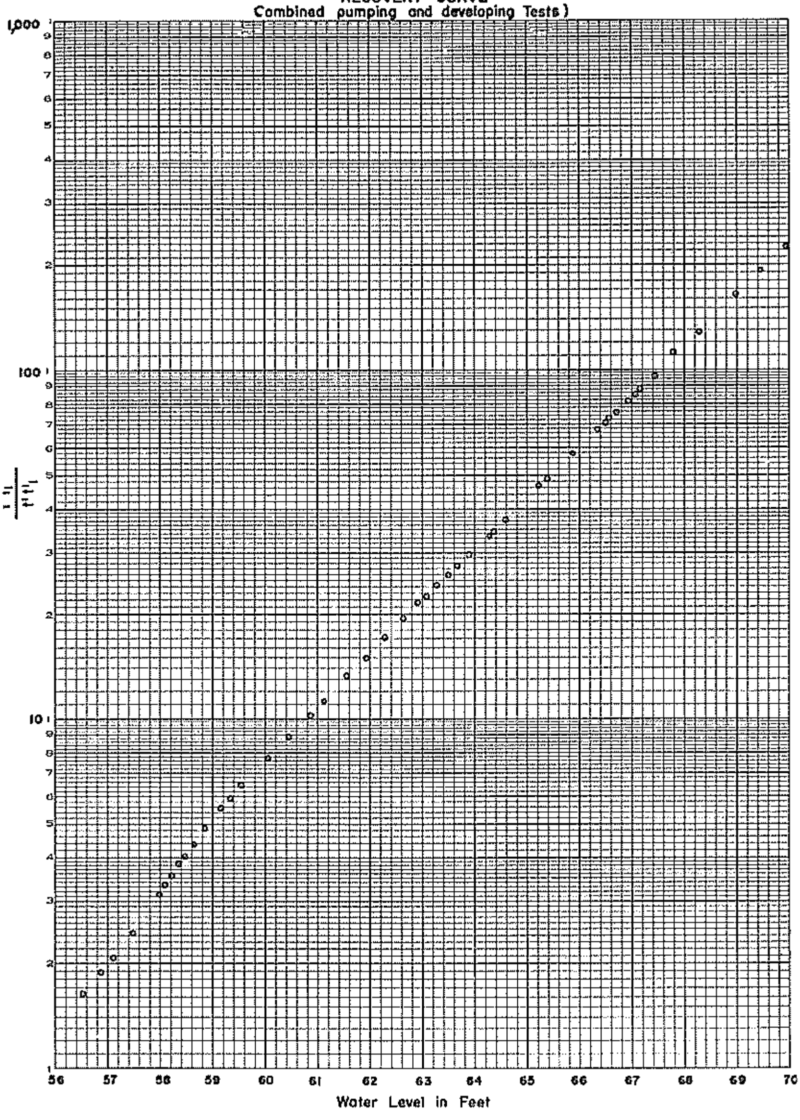
Substituting 6.83, the value of the horizontal intercept between values of $tt_1/t't'_1 = 10$ and 100 gives 17,970 for the transmissibility, or substituting 4.85, the value of the horizontal intercept indicated by the slope of the line below $tt_1/t't'_1 = 7$, gives 25,300 as the value of T. These latter two values give 21,635 as an average value.

INTERFERENCE BETWEEN WELLS

The aquifers encountered all appear to belong to one rather closely related system. Pumping of an irrigation well 113 feet north of the test well had no effect on the water level in the test well when the pumped well was approximately 170 feet deep; however, upon deepening the pumped well to 297 feet shortly after completion of the test well, a 5-

Figure 2

RECOVERY CURVE
Combined pumping and developing Tests)



foot lowering of the water level in the test well was observed after the irrigation well had been pumped several days. Pumping of the test well had little effect upon the irrigation well when the irrigation well was 170 feet deep. The test well was not pumped after the irrigation well was deepened, but such pumping would probably produce a lowering of water level in the shallower well. It thus appears that there will be interference between wells where the lowest aquifer drawn from in one is approximately at the same horizon as the highest aquifer from which the other well draws water. It is also believed that if it were desired to keep separate the water in the various aquifers, cement plugs would be necessary because of the ease with which the intervening clay strata break down and permit the circulation of water.

SUMMARY AND CONCLUSIONS

It appears that the strata below a depth of 450 feet at the site of the test well contain only poor aquifers, as very little sand was encountered below that depth, and it was apparently rather well cemented. Also the well produced from open hole below a depth of 653 feet only 0.2 gallon a minute per foot of drawdown. However, there are porous strata below those utilized at present down to a depth of approximately 450 feet. These lower aquifers have a specific capacity of approximately 10, compared to a specific capacity of about 20 for the shallower aquifers. This lower specific capacity is partially offset, however, by the higher static level of the water in these strata. Thus deep wells from which shallow water is excluded, though having greater drawdowns yet would actually pump about the same quantity of water from about the same level as shallower wells.

The water found in the lower aquifers at the well site does not represent an extra amount of perennially flowing water not hitherto known in the Mimbres Valley. The water in these lower strata is also recharged by the rainfall and seepage from Mimbres River, estimated by White[2] to average about 10,500 acre-feet annually. No increase in the total quantity of water that can be perennially taken from the basin is therefore indicated by the drilling of this well.

However, the proof of the existence of porous strata below those commonly drilled indicates that the amount of storage in the groundwater basin is considerably greater than it was known to be before. Hence, the prospective life of the ground water development can be considered to have been extended by the data acquired in drilling this well. Further, the data show that the water level can be eventually lowered to greater depths than previously anticipated when efficiencies of pumping plants are increased and power rates are reduced.

The immediate and most beneficial effects of pumping from the lower aquifers found by the test well southwest of Deming will be to make the cones of depression formed by pumping wells in this congested area broader and shallower. As a consequence, the interference between the wells in the area will be reduced by tapping the lower aqui-

2 White, W. N., Progress report on ground water supply of Mimbres Valley; New Mexico State Engr., 11th Bienn. Rept., p. 112, 1934.

fers, and wells tapping both upper and lower aquifers will have less drawdown in proportion to their pumpage than those tapping only one set. Because this area is congested, deepening of wells will be desirable. However, it must be remembered that lowering of water levels as a result of such pumping will occur over a larger area than before, and that although more intensive development in local areas is possible, the total quantity of possible development in the whole basin is little if any greater than previously estimated.

CHRONOLOGICAL DESCRIPTION OF DRILLING OPERATIONS

NEW MEXICO STATE ENGINEER DEMING TEST WELL

March 16, 1941 Spudded in well at 3:00 p. m. with a 15-inch star bit using 13-inch bailer, 19 feet long; drilled to 5:00 p. m. Depth 16 feet.

March 17 Built a sample collecting trough and a shelter house. Began drilling at 2:40 p. m., drilled till 6:30 p. m. Depth 48 feet.

March 18 Commenced drilling at 8:15 a. m. Drilled till 11:15 a. m. Depth 57 feet; hole started caving so prepared to run 12½-inch pipe. Changed to 10¾-inch bit.

March 19 Ran 62 feet of 12½ inch pipe. Started drilling at 2:30 p. m., stopped at 6:30 p. m. Depth 88 feet.

March 20 Depth to water 74.39 feet at 7:30 a. m. Started drilling at 7:45 a. m., drilled until 6:00 p. m. Depth 118 feet; pipe to 102 feet.

March 21 Depth to water 74.54 feet at 8:00 a. m. Drilled to 195 feet; pipe run to 163 feet.

March 22 Depth to water 76.70 feet at 7:30 a. m. Drilled to 215 feet; pipe run to 199 feet.

March 23 Depth to water 76.25 feet at 8:00 a. m. Sunday — no drilling.

March 24 Depth to water 74.22 feet at 9:15 a. m. Drilled to 247 feet. Drilling speed cut by material caving into hole.

March 25 Depth to water 67.47 feet at 7:45 a. m. Drilled to 269 feet. Bailer lowered water level only 20 feet with casing at 254.4 feet.

March 26 Depth to water 65.93 feet at 7:30 a. m. Drilled to 297 feet. Pipe to 292.6 feet. Bailer rapidly lowered water level to 280 feet.

March 27 Water had risen from previous day's bailing. Placed 10 sacks of cement in bottom of hole, mixed cement and water in sample trough and lowered it in the bailer,

CHRONOLOGICAL DESCRIPTION OF DRILLING OPERATIONS
Cont'd.

	placed a wooden plug in casing and forced it down to 292 feet with the weight of the tools. Allowed cement to set 72 hours.
March 30	Depth to water 60.88 feet at noon; unusually high water level caused by cement plug in bottom of casing. Drilled cement plug and strata to 311 feet.
March 31	Depth to water 61.80 feet at 7:45 a. m. Drilled to 357 feet, open hole.
April 1	Depth to water 62.00 feet at 8:00 a. m. Drilled to 370 feet. Trouble with swivel socket filling with sand and failing to turn. Hole caving so began running 8-inch pipe, 104 feet of pipe run.
April 2	Depth to water 60.50 feet at 8:00 a. m. No drilling; pipe run to 300 feet.
April 3	Depth to water at 7:30 a. m. 58.36 feet. Encountered sand at 370 feet which rose into casing. Casing had to be kept at drilling level in the sand. Drilled to 419 feet. Pipe to 378 feet.
April 4	Water level at 7:40 a. m. 56.72 feet inside 12½ inch casing and 66.34 feet inside 8 inch. Drilled to 444 feet. Sediments harder and standing up better, but caving somewhat.
April 5	Water level at 7:30 a. m. 55.90 feet inside 12½ inch casing and 74.25 feet inside 8-inch. Drilled to 453; material from above had begun caving badly so ran pipe to 445 feet. Drilled ahead to 467 feet.
April 6	Water level at 8:00 a. m. 55.33 feet inside 12½ inch casing and 66.28 feet inside 8-inch. Drilled to 500 feet; pipe run to 480 feet.
April 7	Water level at 7:30 a. m. 55.11 feet inside 12½ inch casing and 59.16 feet inside 8-inch. Drilled to 541 feet; hole caving so ran pipe to 524 feet.
April 8	Water level at 7:15 a. m. 54.94 feet inside 12½-inch casing and 61.57 feet inside 8-inch. Spliced cable and ran pipe to 539 feet in the morning; then drilled to 557 feet.
April 9	Water level at 7:30 a. m. 57.11 feet inside 12½-inch casing and 61.79 inside 8-inch. Drilled to 570 feet, well caving so ran 1 joint of pipe; drilled to 576 feet and ran another joint of pipe; pipe to 576 feet.

CHRONOLOGICAL DESCRIPTION OF DRILLING OPERATIONS
Cont'd.

April 10	Water level at 7:30 a. m. 54.82 feet inside 12½-inch casing and 58.99 feet inside 8-inch. Drilled to 592 feet; bailed well to see if water was shut off by bottom of casing; water was not shut off. Drilled to 595 feet.
April 11	Water level at 7:30 a. m. 54.81 feet inside 12½-inch casing and 56.74 feet inside 8-inch. Drilled to 618 feet.
April 12	Water level at 7:15 a. m. 54.79 feet inside 12½-inch casing and 56.00 feet inside 8-inch. Stopped drilling at 11:00 a. m. Depth 624 feet.
April 13	Sunday, no work.
April 14	Water level at 7:20 a. m. 54.83 feet inside 12½-inch casing and 55.32 feet inside 8-inch. Drilled to 629 feet; ran pipe to 583 feet. Bailed water down about 200 feet. Drilled to 635 feet, water had recovered from running bailer; dressed bit and drilled to 638 feet.
April 15	Water level at 7:30 a. m. 54.89 feet inside 12½-inch casing and 55.37 feet inside 8-inch. Drilled to 661 feet.
April 16	Water level at 7:15 a. m. 54.89 feet inside 12½-inch casing and 55.19 feet inside 8-inch. Drilled to 685 feet.
April 17	Water level at 7:30 a. m. 54.91 feet inside 12½-inch casing and 55.10 feet inside 8-inch. Worked until noon on swivel socket and mandrel. Drilled to 698 feet.
April 18	Water level at 7:35 a. m. 54.90 feet inside 12½-inch casing and 55.14 feet inside 8-inch. Drilled to 718 feet.
April 19	Water level at 7:05 a. m. 54.90 feet inside 12½-inch casing and 55.11 feet inside 8-inch. Drilled till noon; depth 725 feet. In afternoon rigged up gin pole and 4-line block and tackle.
April 20	Sunday, no work.
April 21	Water level at 7:15 a. m. 54.88 feet inside 12½-inch casing and 55.70 feet inside 8-inch. No drilling; pulled pipe up about 7 feet to allow for operation of

CHRONOLOGICAL DESCRIPTION OF DRILLING OPERATIONS
Cont'd.

underreamer. Removed top 6.6 foot length of casing, bottom of pipe at 576 feet.

April 22 — Depth to water at 7:35 a. m. 54.82 feet inside 12½-inch casing and 54.88 feet inside 8-inch. Underreaming and running casing. Put on 20.3-foot length of casing; 7 feet of which remained out of hole; casing actually in hole 590 feet.

April 23 — Depth to water at 7:40 a. m. 54.88 feet inside 12½-inch casing and 55.17 feet inside 8-inch. No drilling. Underreaming and running casing. Placed 16.6-foot joint of pipe; total pipe 613.5 feet.

April 24 — Depth to water at 7:30 a. m. 54.88 feet inside 12½-inch casing and 55.20 feet inside 8-inch. No drilling. Underreaming and running casing. Placed 19.9-foot length of casing; total 633 feet.

April 25 — Depth to water at 7:25 a. m. 54.84 feet inside 12½-inch casing and 54.90 feet inside 8-inch. No drilling. Rain. Worked until about 11:00 a. m. underreaming and spudding pipe. Pipe did not go down. Worked about 1 hour in the afternoon.

April 26 — Depth to water at 7:30 a. m. 54.74 feet inside 12½-inch casing and 54.68 feet inside 8-inch. No work. Rain.

April 27 — Depth to water at 7:15 a. m. 54.94 feet inside 12½-inch casing. No drilling. Weather improved. Casing went down very slowly to 653 feet.

April 28 — Depth to water at 8:45 a. m. 54.87 feet inside 12½-inch casing and 54.90 feet inside 8-inch. No drilling. Underreaming in morning. Pumped water down 8-inch pipe under pressure in attempt to eliminate freezing of pipe. Attempt unsuccessful.

April 29 — Depth to water at 10:21 a. m. 54.93 feet inside 12½-inch casing and 54.90 feet inside 8-inch. No work. Waiting on 6-inch pipe to continue drilling.

April 30 — Depth to water at 11:30 a. m. 54.98 feet inside 12½-inch casing and 54.49 feet inside 8-inch. Changed tools in preparation for drilling inside 6-inch pipe.

May 1 — Depth to water at 7:20 a. m. 54.98 feet inside 12½-inch pipe and 54.88 feet inside 8-inch. Ran 30 joints of 6-inch casing totaling 679 feet.

CHRONOLOGICAL DESCRIPTION OF DRILLING OPERATIONS
Cont'd.

May 2	Depth to water at 7:40 a. m. 55.02 feet inside 12½-inch casing, 29.34 feet inside 8-inch, and 23.28 feet inside 6-inch casings. High readings in 8-inch and 6-inch casings caused by displacement of water by 6-inch pipe. Strung up tools and cleaned out hole.
May 3	Depth to water at 7:30 a. m. 55.00 feet inside 12½, 55.03 inside 8, and 55.24 feet inside 6-inch casings. Ran pipe to 724 feet. Cleaned out hole to bottom and drilled to 739 feet.
May 4	Depth to water at 7:25 a. m. 54.93 feet inside 12½-inch casing and 54.94 feet inside 6-inch. Drilled to 745 feet.
May 5	Depth to water at 7:15 a. m. 54.93 feet inside 12½-inch casing and 55.03 feet inside 6-inch. Drilled to 762 feet; ran casing to 730 feet, where casing remained until well completed.
May 6	Depth to water at 7:00 a. m. 54.85 feet inside 12½-inch casing and 54.89 feet inside 6-inch. Drilled to 808 feet.
May 7	Depth to water at 7:15 a. m. 54.87 feet inside 12½, 56.74 feet inside 8, and 54.95 feet inside 6-inch casings. Drilled to 825 feet.
May 8	Depth to water at 7:30 a. m. 54.84 feet inside 12½, 54.79 inside 8, and 55.14 inside 6-inch casings. Drilled to 852 feet. No cuttings of material from 845 to 852 feet removed by bailer; appear to go into suspension.
May 9	Depth to water at 7:00 a. m. 54.83 feet inside 12½, 54.79 inside 8, and 55.13 feet inside 6-inch casings. Drilled to 892 feet. No cuttings removed by bailer.
May 10	Depth to water at 7:30 a. m. 54.89 feet inside 12½, 55.93 inside 8, and 56.08 feet inside 6-inch casings. Drilled to 925 feet; bailer started picking up cuttings at 901 feet.
May 11	Depth to water at 8:00 a. m. 54.90 feet inside 12½, 55.93 inside 8, and 56.08 feet inside 6-inch casings. Drilled to 955 feet. Clay material like that encountered at 725 feet caving into hole.
May 12	Depth to water at 12:10 a. m. 54.84 feet inside 12½, 55.57 inside 8, and 55.95 feet inside 6-inch casings.

CHRONOLOGICAL DESCRIPTION OF DRILLING OPERATIONS
Cont'd

	Began two 12-hour shifts. Drilled to 995 feet; material from above falling into hole.
May 13	Depth to water at 9:45 a. m. 54.85 feet inside 12½-inch casing and 56.90 feet inside 6-inch. Completed drilling to 1,000 feet and started pulling 6-inch pipe.
May 14	Depth to water at 7:30 a. m. 54.87 feet inside 12½ and 56.76 feet inside 6-inch casing. Removed remainder of 6-inch casing, and ran bailer from 11:00 a. m. until 2:20 p. m. at 23.2 gallons a minute. Draw water down 100 feet to 155 feet.
May 15	Began perforating 8-inch casing with a Mills knife at 303-306 feet, 328-337 feet, 347-361 feet, and 380-442 feet.
May 16	Water level at 7:00 a. m. 54.81 feet inside 12½-inch casing and 54.97 feet inside 8-inch. Continued perforating.
May 17	Completed perforating 8-inch pipe at 9:30 a. m. Began preparations for pulling Jonas' pump from irrigation well to use in testing State Engineer's well.
May 18	Started collar-buster at 8:00 a. m. to part 8-inch casing at 289.6 feet in order to remove upper joints. Pipe separated at 10:15 a. m. and upper portion removed. Finished removing pump from Jonas' well.
May 19	Placed pump in the test well; bowls of pump (9-inch) at 130 feet, bottom of suction at 144 feet.
May 20	Began pumping (developing) well at 8:30 a. m. Temperature of water 77°F. Measured drawdown and yield.
May 21	Stopped pump at 2:45 a. m. Measured water level recovery until 7:00 p. m., and began pumping test. Measured drawdown and yield. Drawdown approximately 43.4 feet; yield 465 gallons a minute. Collected water sample and found 10 parts chloride per million and 95 parts hardness per million. Temperature of water 75°F.
May 22	Stopped pump at 9:00 a. m. and measured recovery of water level.
May 23	Removed pump from test well.
May 24	Ran bailer to see whether well had sanded up. Very little sand appeared to have settled into well. Eight-inch bailer lowered to more than 700 feet without encountering sand.