Ft. Smith SW. AM. 1927?

Getting the Facts

A gauge to measure the flow of water in the Arkansas river has just been installed on the bridge at Van Buren, as part of a general water power survey of Arkansas. V. L. Austin of Rolla, Mo., the engineer who installed the gauge, said 133,000 million gallons a day was the rate of flow of the Arkansas Monday at a stage of 23 feet. That figure in itself is of little value. But when stream measurements all over the state have been made, under varying conditions and over a considerable period of time, the information thus obtained will be invaluable in forming a policy of flood prevention and control. It is impossible to provide for control of floods without first knowing how much flood there is to control.

This stream measurement is one result of the geological survey act passed by the last legislature. Through a small additional severance tax, the legislature provided funds expected to total about $75,000 a year, to pay the cost of geological, soil and water power surveys of the state. The work is being done under direction of Dr. George C. Branner, state geologist. It will prove one of the best investments this state ever made, for it will reveal much information which cannot be obtained in any way except a detailed examination of the state's geological structures, soils and streams by men trained to observe and know what they have observed.

MUDDY RIVER REACHES NEW FLOOD STAGE

Whole Trees Come Floating Down With Crest. Families Forced to Evacuate Homes in Bottom Lands

Ft. Smith S.W. am.

SHELTER IS PROVIDED

Oct 5 1927

Persons Required to Leave Farms Before Advancing Waters Given Care

The swollen, muddy waters of the Arkansas, loaded with driftwood, Tuesday afternoon reached a crest stage of 24.7 feet at Fort Smith. Whole trees came floating down with the crest, and logs and debris. The high mark was 2.7 feet above flood stage, and a few families were forced out of their homes in the bottoms and received shelter at the Fort Smith Lions club tourist park.

The river had risen 3.8 feet Monday to a stage of 24.2 feet Tuesday morning here. At that time, Fort Gibson, Okla., had a stage of 24.8 feet, a rise of 1.8 feet and Webber Falls, the same stage and the same rise. Flood stage at Fort Smith and Fort Gibson is 22 feet and at Webber Falls, upstream between these two points, it is 23 feet. T. G. Shipman, meteorologist, expected crests of about 25 feet at Fort Gibson and Webber Falls. A gauge on the Fort Smith-Van Buren bridge, registered 24.97 feet Tuesday afternoon.

Prospect Is Brighter

Damage is not heavy until 25 feet is passed, Shipman said. Henry Kaufman, Sebastian county Red Cross chairman, reported that three families were forced out of their homes in the bottoms southwest of Fort Smith, and given shelter at the tourist park here.

With fair weather, the situation seemed improved Tuesday. The forecast is increasing cloudiness and warmer weather Wednesday.

Streams above Fort Smith have reached their crests, Shipman said, except for the middle and lower Verdigris, near Claremore, Okla. The Verdigris will rise one to two days, while other streams are expected to begin returning slowly to their banks Wednesday.

Commissioner W. H. Vaughn of the water department, declared it would take a greater rise than the 37.1 record last spring to affect the clear well at the Fort Smith pumping station, because of the two-foot wall erected around the well.

Readings to Be Taken

Ten river gauges will be installed on main streams in Arkansas by the United States geological survey, in co-operation with the state geological department, to obtain records for use in flood prevention, estimates of water resources, and information as to size of levees and dams that may be erected in the future, according to V. L. Austin, junior engineer of Rolla, Mo., who has just installed a chain and weight gauge on the Fort Smith-Van Buren highway bridge.

Austin said he found that 133,000 million gallons of water passed down the stream Monday at a stage of 23 feet, which is about flood stage. Daily readings will be taken. The speed of the stream has been measured with an instrument resembling a dirigible, and soundings were made.

State records to be taken will be used in flood prevention work, by power plants, for determining the purity of the water supplies, for building of levees and many other purposes, Austin said. Records here also will be used by Shipman.

Gauges Are Used

The flow of the Arkansas here and the depth will be measured several times a year, Austin declared. He said the work in Arkansas has been made possible by an appropriation of the last legislature, and is being done under the supervision of Dr. George Branner, state geologist.

There are now 10 gauges in the state, the engineer said. There are two on the Arkansas, at Van Buren and Little Rock, two on the White river at Newport and Clarendon, one on the Little Red river at Heber Springs, one on the St. Francis at Marked Tree, one on the Big Lake outlet at Manilla, one on the Red river at Garland City, one on the Little Missouri at Murfreesboro, and one on the Ouachita at Hot Springs. A few of these were made possible some time ago by private funds.

STATE STREAMS ARE SURVEYED BY GEOLOGISTS

S.W. Times Record

Use and Control of Waters of Arkansas Is Important, Timely Subject, Report of Department Says

11-13-1927.

(Special News Service)

Little Rock, Ark., Nov. 12.—The following statement on the survey of Arkansas streams has been issued by the Arkansas geological survey:

The use and control of Arkansas streams is a subject of timely interest and great importance. The belief has been widespread that much potential water power exists in the streams of the hilly regions of the state, and that the development of this latent power would be a public benefit. The vast destruction caused by the floods of last spring is still fresh enough in mind to place the subject of flood-control in the front rank of importance.

The potential water power of Arkansas is estimated at more than 300,000 horse power. Up to the present time only about 15,000 horse power has been developed. That the development of the full potential power would be a great benefit in the way of extending the use of electrical service, stimulating manufacture, and creating beautiful lakes and pleasure resorts, is so obvious as not to require discussion.

The amount of power that can be developed from a stream depends upon two factors—the height of the dam and the stream flow. The economic and practicable height to which a dam can be built on any stream can be readily ascertained by a field survey and comparison of relative costs. With the dam height fixed, the stream flow determines the amount of power that can be developed and the amount of money that can be spent in making the development with the assurance that a reasonable return on the investment will be realized.

Flow of Stream Variable

The flow of any stream is quite variable. It varies from day to day, week to week, and to some extent from year to year, depending upon the amount and distribution of the rainfall. Before a company would be warranted in making the relatively large expenditure necessary for the construction of a water power plant, it should have definite records of the stream flow for a period of years, the longer the better. Capital will not be lured into uncertainties. If adequate and reliab[le] information is to the possibiliti[es]

[of a stream is not available, im]provements will be withheld.

In planning any flood-control works, such as levees, spillways, channel improvements or storage reservoirs, the first and most important thing to know is the magnitude and frequency of the floods. It is necessary to know how much water the controlling works will have to handle. Without definite records as to the magnitude of the floods, the proposed improvements would have to be based upon estimates, and this would probably result in many costly errors.

Flow Is Being Studied

In order to provide the basic information which would be required for any well-planned water power development or flood-control project, the state legislature has provided funds for making a systematic study of the flow of the most important streams. This study has been assigned to the Arkansas geological survey, under the direction of Dr. George C. Branner, state geologist. The work is being carried on in co-operation with and through the organization of the United States geological survey under the direct supervision of H. C. Beckman, district engineer for Missouri and Arkansas. The federal survey is doing similar co-operative work in most of the states of the union. It has in a large degree developed the instruments and methods which have been adopted as standard throughout the world. Several public and private parties interested in the results of the work are also co-operating by rendering assistance or contributing financially to its support. The following is a list of those who are so co-operating: United States weather bureau; Arkansas Power and Light company; Ozark Hydro-Electric Power company; Mississippi county drainage district No. 17; Poinsett county drainage district No. 7; Missouri Pacific railroad; St. Louis-Southwestern railway.

Stations to Be Established

Under this co-operative arrangement gaging stations have been or soon will be established at each of the following places:

1. White river at Cotter.
2. White river near Newport.
3. White river at Clarendon.
4. North fork of White river near Henderson.
5. Buffalo fork near Rush.
6. Little Red river near Heber Springs.
7. Big Lake outlet near Manila.
8. St. Francis river near Marked Tree.
9. Arkansas river at Van Buren.
10. Arkansas river at Little Rock.
11. Ouachita river near Hot Springs.
12. Ouachita river at Remmel dam near Malvern.
13. Little Missouri river near Murfreesboro.
14. Red river at Garland city.

Several of these stations were located in accordance with the recommendation of officials of the Arkansas Flood-Control association.

The state of Missouri in co-operation with the United States geological survey is maintaining gauging stations near the state line on several streams which drain into Arkansas. The records collected at these places will also be available for planning improvements on these streams within the borders of Arkansas.

Chain Gauge Installed

At each of these gaging stations a staff or chain gauge is installed on which the stage of the water is read each day by a nearby resident. At a few places recording gauges are used which give a continuous record of the stage of the water. Engineers of the Geological Survey visit each of these gauging stations about once every three months and make measurements of the width and depth of the water and the velocity of the current.

The velocity measurements are made by suspending in the water a small instrument known as a current meter and noting the number of revolutions a minute made by the meter wheel as indicated through an electric circuit. From the measurements of the width, depth, and velocity, the quantity of water flowing in the stream in terms of cubic feet a second is computed. After such measurements have been made at low, medium, and high stages of the stream, a curve is plotted and a table prepared which shows the amount of water flowing for each gauge height throughout the entire range of stage. The daily gauge heights taken by the local observer are then applied to this table to determine the amount of water flowing in the stream for each day of the year.

Records Have Many Uses

As stated before, the principal use of these records is to plan water power developments and flood control works. The records also have several other important uses. Large steam power plants require for their condensers from 600 to 1,000 tons of water for every ton of coal burned. Such plants can therefore be located only where an adequate supply of water at all times is assured.

The records will show where ample water supplies may be obtained for cities and industries. They will be valuable in designing new bridges across the streams and in making studies of pollution of the water from sewage and industrial wastes.

By collecting the records of the flow of the principal streams of the state the basic information is [being] provided which will form an indispensible guide and a strong encouragement to the most comprehensive development of the latent water power resources of the state. The information will also form the foundation for a carefully planned system of flood-control which will prevent disastrous losses to life, health, and property, such as have occurred in the past. The work will therefore be a valuable aid to the upbuilding of the state.

Several New Gauging Stations to Be Established.

Gazette 4/25/28

Two and probably four new gauging stations will be established on rivers in Arkansas this summer, it was announced yesterday by G. C. Branner, state geologist, following a conference with H. C. Beckman, Rolla, Mo., district engineer for the stream gauging division of the United States Geological Survey. Eleven gauging stations were established in Arkansas last year. Data will be available for engineers doing flood control work and for persons interested in power development.

A station maintained at Clarendon for the past several months will be removed to DeValls Bluff and new stations will be established on the Cossatot river near DeQueen, and on the Cache river near Patterson. Stations probably will be established on the Saline river near Benton and on the Black river at Corning. The work is carried on co-operatively by the state and federal Geological Surveys.

GAZETTE 8-11

River Guages Established.

Mountain Home, Aug. 10.—Elbert Smith, of the Arkansas Power and Light Company, Capt. Charles LeVasseur, engineer of Yellville, Ark., and H. C. Beckham, district engineer with the U. S. Geological Survey, passed through here today on their way to the Northfork River, to establish a government gauge in that stream. They recently established gauges on the White river at several points in this section. The gauges will be used to determine the stream flow, in the connection with water power projects.

U.S. Experiments With Concrete River Bed.

Gazette Aug 28

Cincinnati, O., Aug. 27.—(AP)—Experiments in constructing a concrete river bed for the proposed flood prevention dam in the Mississippi river above New Orleans will begin tomorrow in the Ohio river above Cincinnati at Dam No. 36.

Assistant United States Engineer E. W. Buell, Cincinnati, who will conduct the experiment, said it has been found that water flowing over traps of a dam hit the river bed on a slope, bounce off at an angle and cut into the bed in a sloping direction.

It is planned to concrete the bed of the Mississippi where the water strikes after flowing over the traps of the proposed dam. The experiments in the Ohio are to determine the distance the water bounces and will enable engineers to know where to concrete and reinforce the Mississippi river bed.

Geological Survey Starts Water Flow Tests in Ozarks.

Special to the Gazette. 9-11-28

Henderson, Oct. 10.—A large force of men is at work at this place putting a cable across the Northfork river, at the Smith Ferry, in connection with a water flow test of the stream. Cables also are being installed in the Buffalo and White rivers, by the Geological Survey, in conjunction with the Electric Power and Light Company, which has permits for power development in this section.

The cables are fastened in concrete piers on each bank, and are being so constructed that a car can be operated on them like an overhead tram. This car will be utilized in moving the water meters to different parts of the stream.

Power Company Measures Flow of Three Streams.

Special to the Gazette. 9/24/28

Cotter, Sept. 24.—Wire cables are being taken to the proposed water power sites this week on the White, Buffalo and Northfolk rivers, to be used in gauging tests. These cables will be stretched across the rivers, and meters attached, so the flow of the streams can be determined. Tests are being made by the Geographical Survey and the Electric Power and Light Company, which has permits from the Water Power Commission to develop power on these streams.

U. S. Geological Survey Office Opened at Fort Smith.

Gazette 10-20-28

The Water Resources Branch of the United States Geological Survey has opened a district engineering office at Fort Smith with W. S. Frame as district engineer in charge, G. C. Branner, state geologist, announced yesterday.

The district engineer will devote all his time to checking and compiling records of various water gauging stations in Arkansas and three or four in adjoining states. This is the first time the government has established an office in this state to handle water gauging stations and its location in this state is the result of the establishment last year of 15 water gauging stations as co-operative projects between the state and federal geological surveys.

The readings are compiled over a period of years and the various stages and flows of water at different times of the year are interpreted to be used in determining water power, flood control and navigation possibilities.

In addition to the 15 co-operative stations, the district office will look after seven stations heretofore maintained by army engineers. One of these stations is in Oklahoma, three in northern Louisiana and three in Arkansas, the latter being on the Ouachita river near Camden, the Saline river near Warren and Little River near Wilton.

Co-opeative stations established last year in Arkansas are located as follows: Little river, Heber Springs; Ouachita river, Remmel Dam and Hot Springs; Little Missouri river, Murfressboro; White river, Cotter, Newport and DeValls Bluff; North Fork, Henderson; Buffalo river, Rush; St. Francis river, Marked Tree; Big Lake outlet, Manilla; Red river, Garland city; Arkansas river, Little Rock and Van Buren; Cache river, Patterson.

Geological Survey Is to Print Stream Gauging Report.

Gazette 1/3/28

A report on the results of stream gauging in Arkansas is to be printed soon by the state Geological Survey and the Water Resources branch of the United States Geological Survey, it was announced yesterday by G. C. Branner, state geologist. The report will contain a map showing location of 25 stream gauging stations now in operation and will contain full information regarding progress of the work done heretofore by state, federal and private agencies. W. S. Frame, district engineer in charge of the work for the government with headquarters at Fort Smith, is compiling data for the publication. The booklet will contain about 80 pages and will be the first of the kind ever published in Arkansas. It is contemplated that a similar progress report will be published every year. The information obtained from stream gauging will be used in power development and flood control projects.

Opposes Levee Construction as Means of Preventing Overflows

Henry Thane of Arkansas City, Who Has Given Much Thought to Subject, Convinced General Jadwin's Plan Will Not Prove Successful.

Gazette 5/19/29

By Henry Thane.
(of Arkansas City, Ark.)

Levees have been built from the first day the white man landed at New Orleans. For hundreds of years, we have been building levees. Always on the basis of the last flood height, adding two or three feet to take care of a little more water, should it come. In due time, the next flood came and over it went with breaks in the levees here and there. Again the breaks were closed and another two or three feet added to the top. That is the history of levees and levee building. The same thing is now to be repeated.

The writer came here in 1872, found a six-foot levee, and was told: "There has been no overflow for seven years, and no danger of any. Conditions have changed. Our levees will take care of all water that may come." Railroad building was going on with a rush. Everybody appeared prosperous and optimistic. The country was full of all kinds of stock. With the aid of the Tensas Basis Levee District and Mississippi River Commission our levee was raised and enlarged so that the old six-foot levee had in 1922 grown to 30 feet and proportionately in strength. Everybody felt safe. Lands were opened up. New buildings were constructed. "No danger of overflows." It is true 1922 was a close call. The state loaned us 125 convicts who were worked for 36 hours and stopped a threatened break. The levee held. The engineers came along and again enlarged the levee and raised it three feet more. Everybody felt safe. No further danger. The 1927 flood came and our levee was 10 feet too low.

All this reminds me of what an old river engineer told me several years ago, when I met him and I was bragging about our fine country and strong levees: "Thane, the levees are simply an experiment. Every time they break or the water goes over the top, we estimate how much higher they should have been to have held the water back. To that we add, say, three feet and hope that will be enough. It has never been ascertained how high they must be built." I have never forgotten that warning.

Now what is next? More and higher levees. Chief Engineer Jadwin proposes to raise some levees four feet, but the southeast Arkansas front from the Arkansas river levee down for a distance of 35 miles is to be as it now is. Then should another 1927 flood come it will go over the top and cause a break somewhere in this 35-mile front. I quote from the engineer's statement, Of course, Mr. Jadwin expects all his other levees to hold. A wonderful engineering feat!

For hundreds of years, we have been building levees. Always a failure. No one has ever devised a better plan. It reminds us of the old malaria troubles years ago. "You need calomel and quinine. Better take another course of calomel and quinine." The levee breaks; the same remedy—"More and higher levees."

The flood that will pour over the southeast Arkansas front to devastate this part of Arkansas and north Louisiana is to be taken care of by a floodway to be held between two levees. Over a million acres will become worthless.

Fuse Plug and Spillway Levee.

This 35-mile front is to extend from a point some 12 miles, more or less, above Arkansas City, to 20 miles, more or less, below Arkansas City. The west side of the floodway levee is to commence, as near as can be ascertained, where the Arkansas river levee, now being brought down from Pine Bluff, stops; thence it is to go southwest across the various drainage ditches in the county, east of Walnut Lake, Tillar, McGehee and Dermott and on down to Louisiana. The east side floodway levee is to leave the main Mississippi river levee somewhere above Luna; thence southwest, north of Lake Village, to the Macon hills. So the fuse plug levee is to be partly above Arkansas City and partly below Arkansas City.

This 35-mile front is to be left just as it is, except that our information is that a piece of levee of three miles, more or less, right in front of Arkansas City is to be raised, and a run-around levee to be built back of Arkansas City. When this plan has been carried out and perfected, let's see "where we are at."

The people depending on levee protection discovered years ago that there would be no protection unless the Arkansas river and Mississippi river levees were joined. The Arkansas river levee was brought down to within one mile of Cypress creek, with the hope of a few people that the one-mile gap would not let an over amount of flood water through. It was soon discovered that so far as protecting southeast Arkansas and Louisiana and even northern Desha county, the levee was nil; that Cypress creek must be closed or there would be no protection. Thereupon the Mississippi River Commission notified our levee boards that it would not permit the closing of Cypress creek until we had provided sufficient drainage for the rain water that drained from the various bayous into Cypress creek, and which Cypress creek would take into the Mississippi river during low water times. During flood times the water would go through Chicot county down into Louisiana.

Levee District Organized.

On application, the government furnished us with engineers who laid out the present drainage ditches. We organized the Cypress Creek Drainage district, issuing $3,000,000 worth of bonds and the ditches were dug in accordance with the specifications furnished by the government engineers. Two millons of these bonds are now outstanding. The people take the view that if the government is going to destroy our drainage system we will stop paying drainage taxes. A survey of Chicot county shows that 125,000 acres are delinquent. Desha county has fully that amount of forfeited acreage. Again, if the lands in the proposed floodway are not to be protected against flood water, then why pay levee taxes? The same lands are now delinquent for levee taxes, with a million or more of levee bonds outstanding.

These drainage ditches consist of five ditches between Arkansas City and McGehee. They have a total width of something over 700 feet and have a depth of over 20 feet. In the springtime, when heavy rains fall south of Pine Bluff, or in the territory that is drained by these ditches, they become bank full and I have seen them overflow in places a number of times. These two floodway levees will cut this drainage off, and it will be necessary to make ditches on the western sides of these floodway levees of at least 700 or 800 feet in width and 25 feet deep. That water cannot be dumped into Bayou Bartholomew, but will have to be carried on down into Louisiana. During wet season, Bayou Bartholomew has all the water that it can take care of. How this spring rain water is to be taken care of has not been stated.

These floodway levees are based on height of former floods, plus a liberal allowance for any possible increase of flood level. The same basis as has been used in building the main levee. It is an experiment. All the floods that we have had here came from breaks in the Arkansas river levee. Five million dollars is being spent on that levee to make it unbreakable. I wonder what an insurance company would charge to guarantee it! Suppose that the next flood comes; a weak spot develops; a break comes. Where will this water go? It cannot take its usual course down through Desha and Chicot counties, but will go west of the spillway levees to Drew and Ashley counties. If the Arkansas river levee stands and a break occurs either above or below Arkansas City, will the floodway levees hold? The engineers say: "Yes. Our figures show that those levees are built amply high and strong." But, the Mississippi river has heretofore shown utmost contempt for engineers' figures and estimates, and is liable to do so again. The whole scheme is an experiment. Yes, a visionary experiment.

Flood Canal.

The government gauge at Arkansas City to the top of the levee says 62 feet. The same gauge says 42 feet to the top of the natural bank. This gives us 20 feet as the height of the levee. The flood of 1927 reached 60 1-2 feet, or within 1 1-2 feet of the top. The levee at this point is slightly higher than at several other points above and below. Now the plan that we suggest is, instead of waiting until the river gets over the top of the levee and breaks it, and a great flood of water, possibly half a mile wide and at least 20 feet deep, inundates southeast Arkansas and north Louisiana, let the flood canal be dug, commencing, say, near Cypress creek, and make it of a depth of 15 feet and half a mile wide. That means that when the water in the river would get up to 27 feet at Arkansas City (this being 15 feet below the top of the bank), it would commence to run through this canal. The canal should go along the lowest ground west of the river and east of the Ouachita and Black into Red river, thence to the gulf at the nearest practicable point. If this flood canal were now in existence we would today have less than 40 feet on the gauge. The river with a stage of 30 feet will average less than a mile in width, and a flood canal half a mile wide will take half of the flood water. And remember, this canal is a short cut to the gulf.

The ditch from Red river south would have the effect of draining the flood water out of Red river and protect the property along the Atchafalaya. The banks of this canal should be protected by reinforced concrete. The dirt out of this canal should be spread, say, a quarter of a mile on each side, and it could be used also to raise the banks of the canal, say, five feet. That would give the flood water passing through there 20 feet of bank, and avoid the danger of flooding the country alongside the canal.

This canal would take the surplus water from the Mississippi river before it got to be dangerous or up against the levee. It would not interfere with navigation because, with a stage of 27 feet at Arkansas City, there would be ample water in the river for all purposes of navigation. It would also do away with caving banks and keeping up expensive levees and revetments at an enormous annual expense. Taking this surplus water from the Mississippi will relieve flood conditions as far up as Memphis and farther, and on the Arkansas as far as Pine Bluff, and Newport on the White. It would lower the flood level all the way to the gulf and do away with the expensive Bonnet Carre outlet.

Would Stop Levee Building.

Anyway, it is time to stop building high and expensive levees, which are only an experiment, and so far have been costly failures. A survey should be made at once to determine the practicability of a flood canal and also a barge canal. It would cost very little considering the enormous amount of money to be spent under the Jadwin plan. We have made only a preliminary investigation from maps available, but it is our opinion that a flood canal can be completed inside two years, and at a cost of not exceeding $50,000,000.

Nothing but an actual survey will satisfy the people of Arkansas and Louisiana. Let it be made. Let it be made by civil engineers of standing and not under the authority or supervision of General Jadwin. Not a civil engineer has been heard of who endorses the Jadwin folly. Carroll Riker, Prof. Russell Smith of Columbia University and others all condemn it.

Most of us remember the Dayton, O., flood several years ago. Dayton appeared doomed just as our homes and lands now appear to be. Arthur E. Morgan of the Morgan Engineering Company was called in. He prepared and submitted a plan. The army engineers condemned it. The people of Dayton, after a careful study and investigation, adopted the Morgan plan and put him to work, and his company completed it. No more floods at Dayton. That city is prospering. Turn the survey over to Morgan and if he says the canal is impracticable, there will not be a word of criticism of the Jadwin plan from us. But if Morgan 'O. K.'s" it, then put him in charge and let him put it through.

Levees to Be Set Back.

From an address of Commissioner West of the Mississippi River Commission, delivered at Greenville, Miss., we learn that the floodway levees on this side are to be three feet lower than the main river levee, and that the river levees are to be set back in many places. From other reliable sources we learn that the west floodway levee will leave the Arkansas river levee somewhere in the neighborhood of Red Fork, Ark., thence southwestward toward Walnut Lake, from there on south on the east side of Tillar, McGehee and Dermott and on down to Louisiana. The result of that will be that half of Desha county virtually will be abandoned to the floodway. Look at a Desha county map. Stop and think what will happen to Desha county, as well as the north end of Chicot county, as far down as Lake Village.

Now if the present Arkansas river levee below Red Ford or the Mississippi river near Cypress creek, with the river at 60 feet at Arkansas City, breaks, it will make a break of half a mile wide, with the water going through it at a depth of 30 feet or more, supposing that the natural ground will not wash out. Experience, however, tells us that the natural banks will wash out possibly to a depth of 100 feet or more, the water going through, say, for 30 days. The river will cut out a channel miles long. This estimate is based on past experience and observation. Commissioner West says very little about the effect this will have on southeast Arkansas and north Louisiana, but simply speaks of it as the Boueff River (La.) floodway, as though we were not interested. Remember Commissioner West is a resident of Greenville, Miss. And he further says that the land in this floodway is not to be bought and paid for, but simply flowage rights are wanted. Jadwin says that the people living between the floodway levees can go ahead and farm as usual and when they see the flood is coming and the levee about to break, to get up all their valuables and get behind the floodway levees, then, as soon as the flood passed, they can come back and commence farming again. What nonsense and folly!

At the present time the river is 55.5 feet at Arkansas City. A flood at the headwaters of the Arkansas and White, and another at the headwaters of the Tennessee and Cumberland will send the river to 60 feet in short order and over the top. It has been good luck that the Tennessee and Cumberland river flood got here after the Arkansas and White had run out, and saved us from extreme high water this year and another disastrous flood. Had it occurred, the water would not have left us until June. With the fences and improvements all washed away, how will the farmers be able to go back and raise a crop? And what about the hole that has been washed in the river bank and levee? And remember that the month of April is the flood month and also the month to commence farming in this part of the country. Jadwin promises to close that hole in the levee. How long will it take him to do that? The run-around levee built to close the Mound Landing break in Mississippi is not yet completed and they have been working on that for 18 or 20 months, and yet Jadwin says the farmers can go to work immediately after the water goes down and go to farming again with that hole in the river bank and levee! And will the floodway levees stand the enormous flood of water that will pour through that break? Remember that floodway levee is to be three feet lower than the river levee.

We are spending millions of dollars to reclaim the deserts and arid lands of the West, so as to bring more lands into cultivation. That is all right and we favor it, but here is Jadwin, who is going to spend a billion (and it will take all of that before his plan is completed) and proposes to throw out and let go to waste a million acres of the finest land in the world and turn it into a wilderness. If the government is determined to carry out the Jadwin plan, then let it step in and pay the people for the property and improvements, and we are sure that everyone is quite willing to get out and move away. Then let this body of valuable land be turned into a timber, fish and game preserve. Are we making a mistake to call this whole scheme of Major General Jadwin's the "Jadwin folly?"

Also, remember, there are people here who have spent a lifetime here and in eastern Arkansas, who thought they had accumulated something for old age. Now, the "Jadwin folly" is to take what is left for nothing or a nominal consideration, to make safe other communities along the river. Will Congress approve such a plan?

Barge Canal.

When the writer sent out the ship canal proposition of July, 1927, but very little though had been given to the matter except that the writer was convinced something had to be done besides building levees. Others have since looked into the matter and agree that it is practicable except that instead of a ship canal, let it be a barge canal. A barge canal would interfere but little with bridging and rail transportation. This barge canal from the Gulf to Cairo, estimating it at 550 miles, can be built for something like $360,000,000 a mile wide and 30 feet deep, with reinforced concrete walls. I have no estimate on the locks and dams that will be required, but it certainly would not require as much as three hundred million dollars. That would make the total cost a good deal less than a billion dollars.

The Jadwin plan will cost all of a billion dollars and will take from six to 10 years to complete. What have we then? More levees, greater costs of maintenance, more money required for revetment work to protect caving banks after every flood. But the Jadwin plan people would have succeeded in turning a million acres of the finest land into a wilderness, and run thousands of people from their homes. That would be some satisfaction to them!

The cost of the Jadwin plan will complete the barge canal. It will be the greatest inland waterway in the world. By spreading the dirt from the canal for half a mile on each side, it would become the greatest industrial center in our country. It would do away with caving banks and expensive revetment work. It would do away with costly maintenance of levees. It could be completed in less than half the time that the Jadwin plan requires. It could be financed in the same way as was the Panama canal and tolls will eventually pay its cost and a good profit later. Two per cent bonds could be floated for its construction.

The Riker Plan.

C. L. Riker, a civil engineer of New York, of world-wide reputation as a successful engineer in dredging and building dams, submitted a detailed plan for the control and utilization of the Mississippi river, which met with favor by the Reid Committee. However, Coolidge let it be known that he would not approve any plan except such as had the approval of General Jadwin. So, in order to get some relief, the bill embodying the Jadwin plan was passed during the closing hours of the last session of Congress.

Riker has gone to the expense of having his plan printed in pamphlet form, consisting of some 40 closely printed pages, a copy of which this writer has read with a great deal of interest. Not being an engineer, we can only express the opinion of one who has watched the building and collapse of levees for over 50 years.

Riker appears to have made a study of the Mississippi river floods for many years. Twenty years ago, he predicted a flood like the one of 1927 if the levee program continued, and he condemns the Jadwin plan in no uncertain terms. The Reid Flood Control Committee thought enough of the Riker plan to send for Jadwin and attempt to get his opinion. Jadwin, after a few general remarks, disposes of the Riker plan by saying that it is too expensive and is impracticable. The reader will remember that Jadwin's original recommendation to the president was for an appropriation of $275,000,000. When he was called in to make a showing of what he had to do, then the figures were doubled, and it might go to a billion, and after further quizzes by the committee members he admitted that his plan might go to a billion and a half. Yet he told the committee that Riker's plan and estimated cost of $785,000,000 was too expensive!

Briefly, Riker shows that after years of levee building, being set back year after year on account of caving banks and other causes; that now the average width between the two levees is seven miles, and floods are greater than ever. Riker's plan provides for straightening the river, deepening it by dredging, delivering the dirt and mud on the river banks. He would prevent caving banks and make the channel deep enough to Cairo, Ill., for the largest ocean-going vessels, with levees on both sides, the distance between the two levees not to exceed three miles.

Mr. Riker was sent for twice by General Goethals when the Panama Canal was put through by the latter, for consultation, and General Goethals endorses Riker's plan for flood control.

When the city of St. Petersburg, Russia, needed a deep harbor, Riker was sent for. He submitted a plan which was accepted and put through successfully under Riker's supervision.

He was consulting engineer for the contractors who filled the Potomac flats at Washington, and designed the dredging machine which did the work. That dredge discharged 1,500 cubic yards of mud and dirt per hour, delivering it 30 feet above the level of the bank. The discharge pipes were 36 inches in diameter. Among other things pumped through the pipe was a stone weighing 1,300 pounds and an old iron safe, 25 by 16 by 14 inches. Whenever and wherever difficult work in dredging and dams was necessary, Riker was sent for, and his plans adopted.

The Reid Flood Control Committee made a very strong adverse report on the Jadwin plan, and we quote it only in part, as follows:

"1. That it is lacking in engineering details and has not a sufficient factor of safety; (2) that it uses new and untried methods in the diversion of the flood waters; (3) that the "fuse plug" levees will not work and disaster will result; and (4) generally that it is not dependable and is not feasible from an engineering standpoint. The committee did not believe it probable that so many eminent engineers could all be wrong and therefore refused to adopt the Jadwin plan as the project for the flood control work.

"Instead of the Jadwin plan, if adopted by Congress, providing protection from the floods for the lower Mississippi valley, it might result in the reoccurrence of a disaster like that of 1927."

There is not a civil engineer who endorses the Jadwin plan. His experience in dredging and flood control work is nil. We are sorry that we cannot discuss Riker's plan more fully. We only can say that he has been a success in all of his undertakings and we say "Let him go ahead." Anything except more levees and more disasters. Let us have a Board of Civil Engineers—a board not tied up by army regulations.

Unbiased Board of Engineers.

We have shown as plainly as could be done the folly of further levee building. The writer has been through every overflow and flood since 1874. He was an earnest advocate of levees, aided as a property owner and lawmaker, and agreed with engineers that it was only necessary to build the levees higher and stronger and we would be safe. The 1927 flood took all the levee enthusiasm out of us and we then studied along other lines.

The successful building and operation of the Panama Canal was considered. Instead of being a liability, this has developed into a revenue producing investment. The thought occurred: "Why not a ship or barge canal from the Gulf to Cairo?"

The question of cost came up, an engineer friend was consulted and he furnished an estimate showing that a barge canal along the low lands west of the Mississippi river, one mile wide and 40 feet deep, say 550 miles long, with reinforced concrete walls, could be built for $360,000,000, to which the cost of locks and dams must be added; estimating them at about the same, would be, say $700,000,000. This would cut the water distance to the Gulf one-half. The tolls from shipping and other revenue will soon pay for the original cost and bring in a net revenue. If the necessary legal authority could be obtained, we believe private capital would build the canal. The canal would take care of all the surplus flood water of the Mississippi river and do away with costly levee and revetment work.

The old Father of Waters is not going to wait on canal completion or the completion of the "Jadwin folly" a sshown by the present high water. Something must be done at once, and we have submitted a plan for a flood canal half a mile wide and 15 or more feet deep, commencing at some point above Arkansas City. This we feel certain can be completed in two years (high water in the Mississippi river will not interfere with digging) and at a cost of less than $50,000,000. If this canal was now in existence, the Knowlton and Laconia disasters would not have happened and thousands of people now homeless and living on charity would be pursuing their usual avocations. A similar flood canal from Cairo to White river would take care of eastern Arkansas.

We have discussed the Riker plan briefly. All we can say is that he stands at the head of his profession and is staking his reputation as an engineer on the success of the plan, if adopted. We have discussed the whole situation as briefly as possible. We of southeast Arkansas and north Louisiana are vitally interested in the flood control situation. More levees and higher levees means simply greater disaster. Millions have been spent on levees now; it is proposed to spend millions more. A waste of money and no guarantee of protection!

The writer has no personal ax to grind. He believed this was one of the garden spots of the world and still so believes, but a different plan for its protection must be adopted. Any plan except more and higher levees.

A barge or flood canal from Cairo to White river will not only relieve eastern Arkansas, but will draw so much flood water from the Mississippi that it would lessen the floods in the upper rivers. When this flood water gets into the lower White river, it would go into the Mississippi, thence into the canal above advocated.

Twenty-seven states are directly interested in flood control of the Mississippi valley. Experience has shown us time and time again that we can not depend on levees. Then why not at once authorize a board of civil engineers to examine the Jadwin plan, the Riker plan, Barge or Flood canal, or any other plan? Our people will not be satisfied until the question is settled by an unbiased Board of Engineers.

SURVEY OF STREAMS SHOWING PROGRESS

First Reports of Inventory Will Be Ready by December.

Gazette 7-22-29

Washington, July 20.—(AP)—First reports on the most exhaustive inventory ever undertaken of the potential resources of 200 of the country's principal streams are being prepared by War Department engineers for submission to Congress in December.

The scope of the study is so vast that when it is completed about three years hence, Congress will have available detailed information on navigation, water power, flood control and irrigation possibilities of the rivers, over some of which the federal government has not assumed jurisdiction.

Congress Authorizes Study.

Congress authorized the study two years ago and has voted $12,322,000 to finance it. The primary purpose is to provide a guide for Congress, the Federal Power Commission, state utility commissions and private enterprises in the future development and use of the country's resources and to block unwise schemes and assist sound projects.

More than 700 civilian engineers, 50 army officers, and some of the personnel of the Geological Survey, the Coast and Geodetic Survey, Agricultural Department engineers, the Reclamation Bureau and Weather Bureau are employed in the study. In addition, assistance is being given by state engineers.

Although the study began only 18 months ago, preliminary reports have been completed on about 80 rivers and final reports on 30 streams are expected to be submitted December 1.

Guide for Improvements.

They will indicate locations for reservoir sites and their capacities, location and practicability of dam sites, and capacities of power sites, probable power markets and the general scheme best adapted to a comprehensive utilization of the water resources of each stream. Recommendations as to the best methods of flood control, improvement of navigation and use of water for irrigation purposes also are to be important parts of the reports.

Before reports on the Mississippi tributaries are submitted to Congress they will be referred to the Mississippi River Commission to give it an opportunity to formulate recommendations. The effect of tributaries of the Ohio, Missouri, Arkansas and Tennessee and the question whether the present improvements and uses for water power on them have developed their maximum potentialities present a problem that will require about two years study.

STREAM GAGING IN STATE DESCRIBED

Report on Information Gained Since 1857 Ready for Distribution.

Gazette 1-4-30

All information about streams in Arkansas, collected since 1857 and continuing through 1928, is contained in the Arkansas Stream Gaging Report No. 1, of the Arkansas Geological Survey, which has just been released from the printer and is ready for distribution here. The co-operation of the United States Geological Survey was obtained in compiling the report. Each bit of information, however fragmentary, recorded between the two dates mentioned is contained in the bulletin, which is said to be of unusual value as it is the first publication of its kind here.

Stream gaging is a study of the flow of streams carried on all over the United States by the United States Geological Survey in co-operation with the various states. A small group of men initiated these studies some 40 years ago as a public service to the nation, and have seen their efforts bear fruit. Success has justified their efforts and self-sacrifice, and the ridicule heaped on the then youthful enthusiasts has long since been forgotten.

The starting of this work was not an easy task. Little sympathy was given the men of vision who predicted the future needs for exact scientific facts. It has been said that there are three types of missionaries: the preacher, the pioneer and the engineer. And it is true that as the nation developed westward these three were to be found moving together. So an engineer has always been of a self-sacrificing inspired nature, with something of a religion of public service. It was this element in the technical men of the eighties which gave them persistence in urging Congress for funds for a study of water resources. Maj. John Wesley Powell initiated the movement and finally obtained a small appropriation in 1888, sufficient to organize work in a number of localities. As the years passed, by constant working for and obtaining more funds, more and more stream-gaging stations were established; and along with them grew an appreciation on the part of engineers and economists of the importance of this work in water power development and the many other phases of the conservation and use of water.

The public has become aware of the vital importance of a reliable knowledge of the water resources of the country, and of conserving these resources to the end that they may be fully utilized in human service. We have learned that our supplies, if large, are not inexhaustible. We depend more and more upon careful scientific research into details, and upon more accurate and consequently more expensive records.

How Work Is Handled.

The work is handled through district offices in charge of a district engineer, supported by a thoroughly trained personnel, under the direction of Nathan C. Grover, chief hydraulic engineer, and of John C. Hoyt, chief of the Division of Surface Water. For Arkansas the district office is located at Fort Smith and is in charge of John H. Gardiner, district engineer. District offices are located with respect to the states cooperating in the work. Offices are now located as follows: Albany, N. Y.; Asheville, N. C.; Augusta, Me.; Austin, Tex.; Boise, Ida.; Boston, Mass.; Chattanooga, Tenn.; Chicago, Ill.; Columbia, S. C.; Columbus, O.; Denver, Col.; Fort Smith; Hartford, Ct.; Helena, Mont.; Honolulu, T. H.; Idaho Falls, Ida.; Indianapolis, Ind.; Lansing, Mich.; Los Angeles, Cal.; Madison, Wis.; Ocala, Fla.; Portland, Ore.; Rolla, Mo.; Salt Lake City, Ut.; San Francisco, Cal.; South Charleston, W. Va.; St. Paul, Minn.; Tacoma, Wash.; Topeka, Kan.; Trenton, N. J.; Tucson, Ari.; Tuscaloosa, Ala.; University, Va.; Washington, D. C.

Working from these local headquarters, engineers make frequent current meter measurements, check daily gage readings as obtained at their various stations, compute their data and prepare it for publication. The personnel is drawn from universities in various sections of the country. As brought together in a district office, they become a part of the community, become familiar with local problems, and so become a representative unit acting for the welfare of that community.

Work Begun in 1927.

The work in this state was begun in July, 1927, following the action of Dr. George C. Branner, Arkansas Geological Survey, in effecting co-operation with the United States Geological Survey. Although short periods of records had been obtained prior to this date, the work as now conducted is on the most comprehensive scale. It is not, however, adequately financed and there is a real need for more attention on the part of the state in making available more funds not only to continue the valuable records of the past three years, but to enlarge the scope of the work and increase its accuracy. In the matter of financing the federal government matches any state money on a dollar-for-dollar basis.

What benefit will the state of Arkansas receive from these stream-flow records? It should be recognized that there are now gaging stations on the major streams of the state and that expansion and improvement of the program is contemplated. With accurate data on stream flow officials of the state can show that this state has certain advantages, that it is possible to utilize the water resources in water power development and to bring in industries which can avail themselves of this power and utilize local supplies of raw materials. Arkansas has a potential of about 528,000 horsepower and a development of only 55,200 horsepower with the completion of Carpenter dam.

It should be the duty of the state to promote its development by planning the most complete use of its water and water power. By being in a position to determine reasonable flood control measures, drainage projects, river navigation, land protection, power development. Investors and others will be guided and introduced by the data collected, valuable natural assets will be utilized and opportunities for prosperity will be realized.

CONFERS WITH BRANNER.

John C. Hoyt, assistant chief hydraulic engineer of the United States Geological Survey, and John H. Gardner, district engineer, in charge of stream gauging work in Arkansas and Oklahoma, conferred with State Geologist G. C. Branner yesterday regarding the work in Arkansas. The Geological Survey and co-operating agencies maintain 19 stream gauging stations in Arkansas.

Stream Measurement Program To Be Continued.

Aug 25-1932

Arrangements for continuation of the state and federal stream measurement program for the fiscal year 1932-33 have been completed, it was announced yesterday by G. C. Branner, state geologist, following a conference with N. C. Grover, chief of the Water Resources Branch of the United States Geological Survey, and John H. Gardiner, United States district engineer for Arkansas. Stream flow measurements are being taken regularly at 12 different points in the state, principally for the purpose of determining available hydro-electric power.

Arkansas Allotted $6,000 For Stream Gauging Stations.

Washington, July 18.—(AP)—The Geological Survey today anonunced the allotment by states of $500,000 received by it from public works funds for rehabilitation of stream gauging stations. The allotments included: Alabama, $11,000; Arkansas, $6,000; Florida, $6,000; Georgia, $5,000; Louisiana, $300; Mississippi, $8,000; North Carolina, $14,000; South Carolina, $10,000; Virginia, $15,000.

BUILDING STREAM GAUGING STATION

Work Under Way at South End of Main Street Bridge.

Gazette Nov. 5, 1933

Work has been started on a permanent stream gauging station of the automatic recording type on the bank of the Arkansas river at the Little Rock end of Main street bridge, it was announced yesterday by George C. Branner, state geologist.

The station will be constructed by the federal government from an $8,000 allotment from public works funds for rehabilitation of river measurement stations in Arkansas. The work is being done under immediate supervision of C. L. Young, junior engineer at the Fort Smith district office of the United States Geological Survey, and under the general supervision of John H. Gardiner, district engineer.

The major cost of the work will consist of labor hire, which is being handled through the office of W. A. Rooksbery, state re-employment director.

The Little Rock station will be in the form of a well with eight-inch reinforced concrete walls, the bottom extending about three feet below minimum flow and the top extending above the maximum flood stage set by the highest known flood in 1833. The well will be surmounted at the top by a shelter house, a water-stage recorder and a transmitter, which will be connected with the United States Weather Bureau office, permitting a continuous recording of the river stage without the necessity of visiting the station to take readings.

Method of Operation.

The instruments will be operated by a float on the well water surface, which will be maintained at the same level as the river water through intake pipes. The records obtained will combine the requirements of United States Army Engineers, Geological Survey, and the Weather Bureau in the one gauging station.

Stream velocity measurements will be made from the Main street bridge with which the station will be rated, providing daily discharge records in cubic feet per second. The data thus obtained are essential to flood control work, sanitation, city water supply, navigation, etc., in connection with the Arkansas river.

Through the temporary assistance of army engineers, maintenance has been provided for this gauging station in lieu of the recent discontinuance of co-operation with the Arkansas Geological Survey, due to lack of funds.

Other gauging station locations being considered under this program are on White river, Little river (Sevier and Little River counties), Red river and on Arkansas river near Fort Smith. The construction of these stations, however, will depend largely on whether maintenance funds can be secured from those interested in obtaining the records, Mr. Branner said.

HOW STREAM GAUGING SERVES THE PUBLIC INTEREST.

The Joint Budget Committee has approved a bill to appropriate $1,500 for stream gauging in 1936 and a similar amount for 1937.

Stream gauging is measuring the flow of water in a stream. It gives precise information about the quantity of water that passes the gauging point every day in the year, and the monthly, seasonal and annual flow.

What practical good is there in knowing that?

Without such knowledge we have to build highway bridges by guesswork. If we build them higher or longer than is necessary we waste money. If we build them too short or too low we run the risk of having the approaches flooded or the structures themselves washed out. The same reasoning applies to levees.

A number of Arkansas communities are considering the acquisition or improvement of water works with federal assistance. Records of the stream flow in proposed gathering basins may be basic data called for by PWA to accompany applications for loans and grants.

The whole rice section has a vital interest in water supply for irrigation. Trustworthy information about the surface flow that might be impounded to supplement ground water is needed.

The government will match dollar for dollar any money we appropriate to continue the co-operation we began in 1927 with the stream-gauging program of the United States Geological Survey in Arkansas. This 50-50 fund will be used to obtain information vitally needed in many parts of the state. But if we do not co-operate the federal work will be confined to streams presenting federal problems.

The stream-gauging appropriation bill has been endorsed by the Arkansas Municipal League, composed of city executives; by the Arkansas Engineers Club and by the Arkansas Waterworks Conference, whose membership includes superintendents of municipally-owned water systems throughout the state.

Stream Gauging Paves Way for Development of Waterpower

Fort Smith Times Record
Jan. 12, 1931

Methods of stream gauging for the utilization of water power in Arkansas are depicted in the photographs above. More than one-tenth of the available water power in Arkansas is now developed, or will be developed in the near future, according to Arkansas' stream gauging report No. 1, which has just been released by the Arkansas geological survey. At the left is shown how high water measurements are made from cable cars. This scene was made on the Buffalo river. At the right above is shown an engineer taking measurements by wading out into Mulberry river.

LITTLE ROCK, SUNDAY, JANUARY 22, 1933.

Checking the River Flow

The Water Volume of Arkansas Streams Is Measured at Regular Intervals by the Arkansas Geological Survey, in Co-operation With Federal Authorities, and the Information Thus Obtained Is of Great Value in Future Development of the State.

Gazette

By GEORGE C. BRANNER
(State Geologist)

Water is necessary to all forms of human endeavor and its abundance is often a decisive factor in the growth of a community. The streams of Arkansas are an inexhaustible asset to the state and constitute one of her most valuable natural resources. They supply water for domestic and industrial use, generate hydro-electric power, and are of great recreational value. Several of the deeper streams provide low-cost transportation.

Stream gauging, which is the periodic measurement of the water volume flowing in streams, is now maintained in Arkansas as a state-federal co-operative project. The State Geological Survey, with headquarters at Little Rock, co-operates with the United States Geological Survey, which maintains a district engineer's office at Fort Smith, with John H. Gardiner as district engineer. Inquiries from all parts of the nation are received by Mr. Gardiner concerning available discharge records of Arkansas streams.

From 1903 to 1906 only the United States Geological Survey collected scattered stream-flow records. During 1909-1910 the records were collected co-operatively by both the state and federal surveys. From 1911 to 1926 no information, exept that gathered by a few private interests, was collected. Since 1927 stream gauging has been conducted under the state-federal co-operative basis referred to. All of the stream-flow data available from 1927 to 1928 was published in 1930 by the Arkansas Geological Survey in its stream gauging report 1, "Stream Gauging in Arkansas from 1857 to 1928," by W. S. Frame. Since 1930, however, it has not been possible to publish a state annual report on stream gauging because of insufficient funds.

It is common observation that there are seasonal and yearly fluctuations in the amount of water carried by streams. This is, of course, due to variations in rainfall. The extremes in the annual precipitation in the state during the 38-year period from 1891 to 1928 inclusive, have varied from 35.27 to 65.86 inches. Because these fluctuations are yearly as well as seasonal, it is necessary that continuous records be kept and data collected over long periods, in order that average volumes as well as maximum and minimum volumes be known. Without relatively complete records, full economic utilization and control of streams becomes impossible.

Both fuel and water power developments are dependent upon available water supply. Statistics in regard to stream-flow are necessary before a steam power plant can be installed on a stream because of he considerable volume of water required supply the condensing system. In the se of a hydro-electric installation, the ount of power that can be developed ends upon the fall in the stream and quantity of water available. As the tity of water varies from day to day, al n to season, and year to year, it is ve sary that records of stream-flow be as ble for several years, in order to de- is e the varying rates of discharge to ur ected in the future. With such rec- vill vailable power development can lso at a rate commensurate with und emands, whereas with only meager at available, power development is up-

lla- stimated primary horsepower ob- 100 per cent of the time) and sun horsepower (available less than the at of the time) of the 11 principroducing streams of Arkansas. the in Table I on page 8.

ary and secondary water power which has been developed by the five hydro-electric plants within the state, compared with the estimated potential power available, is set forth in Table II.

Those estimates indicate that a little more than one-tenth of the available water power in the state is now actually developed. It is obvious, therefore, that there is adequate undeveloped water power in Arkansas at the present time to meet any industrial needs which may arise for some time to come.

The production of both hydro-electric and steam-generated electric power generated in Arkansas during the years 1920 to 1931, inclusive, is shown in Table III.

The figures in Table III do not, however, give a key to the actual consumption within the state on account of the exportation and importation of the electric power. State consumption figures are available only for the years 1926 and 1929, as follows:

1926	224,307,337 K. W. H.
1929	470,272,537 K. W. H.

The above figures bring out the fact that in 1926 and 1929 only about 73 per cent and 27 per cent, respectively, as much power was generated in the state as was used therein, and indicates a remarkable increase in the importation of power.

Closely related to the development of hydro-electric plants are the recreational and resort possibilities of the lakes formed by them. Lake Catherine, with a shore line of 80 miles, and Lake Hamilton, with a shore line of 240 miles, near Hot Springs, which were created when the Arkansas Power and Light Company constructed the Remmel and Carpenter dams on Ouachita river, are examples of lakes of this type. Had not stream gauging records indicated the feasibility of these power installations, the erection of these dams would have been retarded and the resultant recreational and tourist interest in the region would have been delayed.

Damage by floods in the state has not infrequently amounted to hundreds of thousands of dollars in a year, and in the flood of 1927, estimated damages of $40,000,000 occurred in the 19 counties flooded by the Arkansas river alone. The protection of land subject to overflow can be adequately and completely provided for only after stream flow records have indicated the maximum quantity of water carried by the main streams and their principal tributaries. The wide variation between minimum and maximum flows which is primarily responsible for floods, is shown in Table IV.

Stream pollution increases with growth of population and industrial development and, as the dilution of sewage and industrial waste by streams is proportional to the quantity of water flowing, a knowledge of minimum stream-flow is essential to proper sewage disposal. If not properly controlled, especially in times of low water, sewage and industrial waste dumped into streams may so contaminate them that the pollution becomes a serious menace to public health and may, in addition, cause a high mortality in fish life. The design and operation of city sewage disposal plants is directly dependent upon knowledge of minimum stream-flows.

Stream-flow information is of essential value in the designing of a drainage project as it is necessary to know accurately the quantity of water which is moving into an area to be drained in order to design the artificial channels necessary to drain the area. Two drainage districts, one in Poinsett county and the other in Mississippi county, co-operate with the state-federal stream gauging program in order to obtain stream-flow records in their territory.

Stream-flow data, especially those relative to minimum flow, are required by engineers on streams open for navigation in order to supply information as to the depth of water available for navigation. According to the War Department definition, there are 1,904 miles of navigable streams in the state, exclusive of the Mississippi river.

The technical work of stream gauging consists of a series of discharge measurements and a gauge-height record. A discharge measurement is made by taking about 20 or more stream velocity and depth observations across the stream channel. The cross section area and average velocity of the stream is thereby determined and from these figures the volume of flow in cubic feet per second may be computed. A discharge measurement requires from two to four hours of work and results are then referred to the established gauge of the station at which it is made. Daily readings are made on this gauge by a paid observer living nearby. With a series of discharge measurements made during the climatic year at varying gauge heights or stages, a stage-discharge relation can be established. By applying this stage-discharge relation to the daily gauge readings, the daily discharge in cubic feet per second may be computed. On account of the changing cross section of the stream, the stage-discharge relation changes and is seldom permanent for over a year, so that to maintain accuracy, discharge measurements are required at regular intervals of usually a month or more.

The office work and computation of field data consume the major portion of the district engineer's time and involve many hydraulic problems. The work, as handled by the United States Geological Survey, is recognized as accurate by engineers and investors throughout the nation.

Twelve gauging stations are now being operated in Arkansas and there are 13 additional points where gauging stations are needed to give information now being requested by engineers. Both the stations in operation and the points where additional stations should be located are shown on the accompanying map.

Some of the stations now in operation are nearly five years old while others have been in operation only a few months. To obtain a stream gauging record of highest value, a continuous series of observations should be made over an interval of from 10 to 50 years. After the key stations are established on major streams, minor tributaries can be studied over short intervals to obtain supplementary information at small expense.

The full utilization and control of Arkansas streams is dependent upon the continuation of the stream gauging work now in progress and the enlargement of the scope of this program. The collection of discharge data at the present time is definite preparation for the future, insuring development of these resources as rapidly as the requirements of good business permit. In addition, the collection of

(Continued on Page 8.)

Stations 1 to 12 established. 1. White river near Flippen. 2. Buffalo river at Rush. 3. North Fork of White river at Henderson. 4. Little Red river near Heber Springs. 5. Spring river at Ravenden. 6. Eleven Point river at Eleven Point. 7. Big Lake outlet near Manila. 8. St. Francis river floodway near Marked Tree. 9. Lee creek at Van Buren. 10. Arkansas river at Van Buren. 11. Ouachita river at Remmel Dam near Malvern. 12. Little river at Horatio. Records are in demand for stations 13 to 25, but stations are not established. 13. Spring river at Hardy. 14. Strawberry river at Evening Shade. 15. White river at Newport. 16. White river at Des Arc. 17. Mulberry river at Mulberry. 18. Petit Jean creek at Danville. 19. Fourche Le Fave river near Nimrod. 20. Arkansas river at Little Rock. 21. Caddo river at Glenwood. 22. Ouachita river at Arkadelphia. 23. Little Missouri river at Murfreesboro. 24. Saline river at Warren. 25. Red river near Garland.

see next page.

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Checking the River Flow

(Continued from Page 1.)
stream-flow data places these Arkansas resources in a position where they can compete with other states. While the water resources of this state may be of less value, they can, because of their more complete stream gauging records, offer more protection to capital investment.

Statistics on Water Power

Gazette 1-22-33

TABLE I.

Stream	Number of Dams	Primary Power Available 100% of the Time (H. P.)	Economic Secondary Power Available Less than 100% of the Time (H. P.)	Total (H. P.)
White River	1	194,000	74,000	268,000
North Fork	1	66,500	8,700	75,200
Ouachita River	3	54,000	......	54,000
Buffalo River	1	21,000	5,400	26,400
Little Red River	3	9,000	40,000	49,000
Strawberry River	2	6,000	3,000	9,000
Spring River	5	5,000	3,000	8,000
Caddo River	1	3,500	20,000	23,500
Fourche LaFave	1	3,500	3,000	6,500
Cossatot River	2	1,200	3,000	4,200
Little Mo. River	1	1,000	3,000	4,000
	20	364,700	163,100	527,800

TABLE II.

Developed Water Power in Arkansas (H. P.)	Estimated Potential Economic Water Power Available in Ark. (H. P.)	Per Cent Developed Water Power	Estimated Potential Water Power Available in Ark. (H. P.) U. S. Geol. Survey, 1928	Per Cent Developed Water Power
Primary 6,400 (1)	364,700 (1)	1.2	201,300 (3)	3.1
Secondary 48,815 (2)	163,100 (2)	29.9	299,300 (4)	16.3
55,215	527,800	10.5	500,600	11.03

(1) For water available 100 per cent of the time.
(2) For water available less than 100 per cent of the time.
(3) For water available 90 per cent of the time.
(4) For water available 50 per cent of the time.

TABLE III.

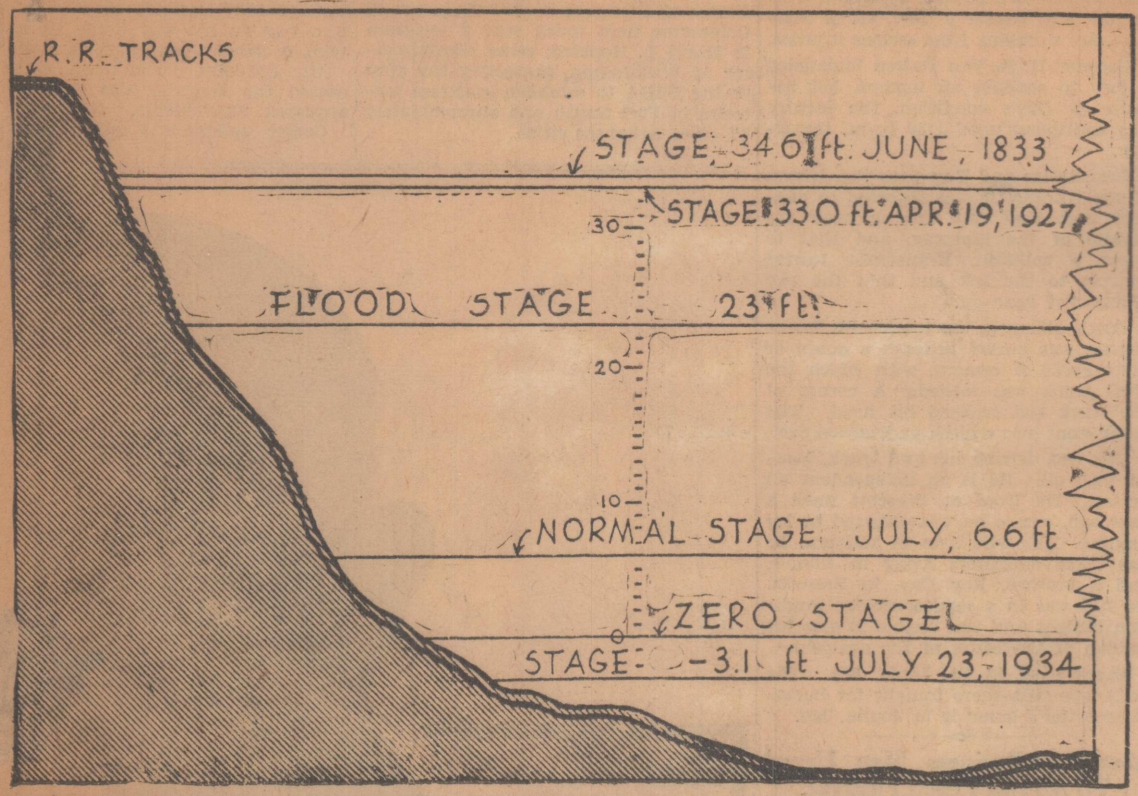
Year	By Fuel Power	By Water Power	Total K. W. H.
1920	117,337,000	1,373,000	118,710,000*
1921	123,014,000	1,438,000	124,452,000
1922	128,915,000	1,649,000	130,564,000
1923	145,895,000	1,880,000	147,895,000
1924	152,035,000	2,647,000	154,682,000
1925	166,070,000	22,470,000	189,070,000
1926	130,662,000	33,035,000	163,697,000
1927	116,590,000	50,289,000	166,879,000
1928	109,800,000	39,783,000	149,583,000
1929	77,644,000	50,195,000	127,839,000
1930	68,404,000	39,767,000	108,171,000
1931	68,115,000	37,096,000	105,211,000

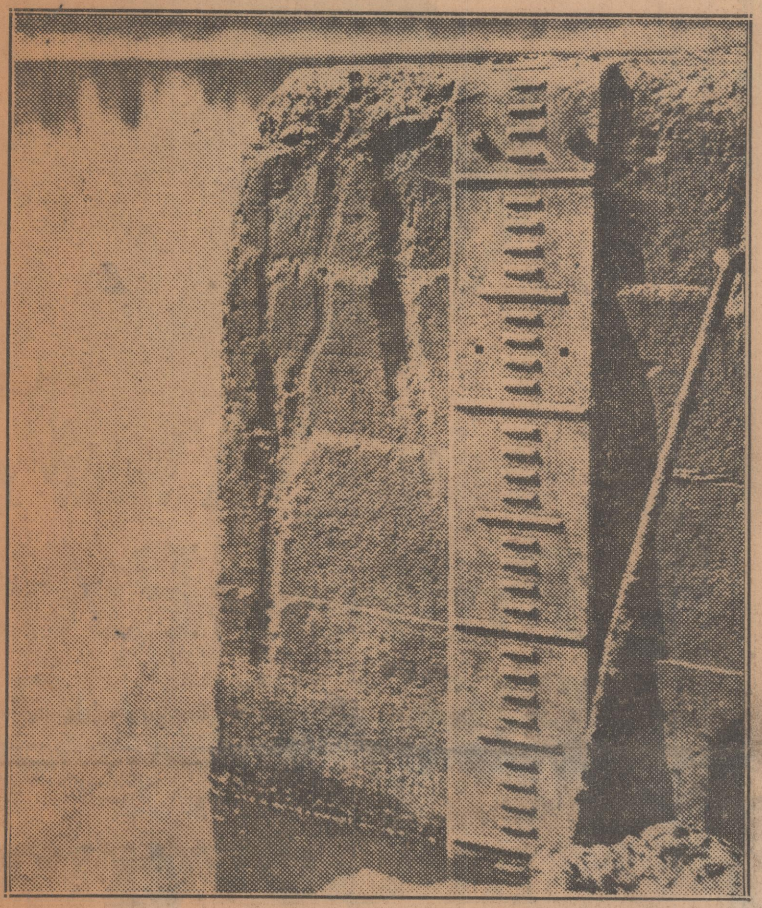
* Partially estimated.

TABLE IV.

Stream	Location	Minimum Cu. ft. per Sec.	Maximum Cu. ft. per Sec.	Ratio Max. - Min.
Arkansas	Little Rock	1,058	813,290	769
White	Clarendon	4,900	440,000	90
Red	Denison, Tex.	145	132,000	910
Ouachita	Hot Springs	32	143,000	4,470

Here's Answer to Question: How Low Is 3.1 Feet Below Zero on Gauge Used to Measure Arkansas River Stages?




—Gazette Staff Photo

The sketch, which Harvey S. Cole, meteorologist of the Little Rock Weather Bureau, prepared yesterday at the request of the Gazette, gives an idea of just how low a stage of 3.1 feet below zero (yesterday afternoon's record reading) is when compared to a normal stage for July, to what is known as "flood stage" to the highest stage of 1927 (year of the last great flood), and to the record high of all time. The gauge which Mr. Cole is using to read the river stages is shown in the photograph. It is on a west pier of the Main Street bridge. Another gauge is used when stages are above zero, but the river already has dropped below it. If the river falls another three inches at this point, it will be necessary to set up an auxiliary gauge.

WEATHER FORECAST.

Arkansas: Generally fair Tuesday; Wednesday partly cloudy to unsettled, continued warm.

Louisiana: Partly cloudy Tuesday and Wednesday, possibly local showers in south portion.

Oklahoma: Partly cloudy to somewhat unsettled Tuesday and Wednesday, possibly local thundershowers in northwest portion.

East Texas: Partly cloudy Tuesday and Wednesday, probably showers near East coast.

LOCAL RECORD YESTERDAY.

	Bar.	Tem.	Wb.	Rh.	Wd.	Wth.	Prec.
7 a. m.	—30.03	78	70	67	NW	clear	0.00
12 noon		98	74	30		clear	0.00
7 p. m.	—29.94	100	75	30	SE	clear	0.00

Highest temperature, 103; lowest, 77.

Departure from normal precipitation since January 1st, —4.47 inches.

RIVER STAGE FALLS AS MERCURY RISES

Record Low Water Mark of 3.1 Feet Below Zero on Gauge Set.

Gazette July 24, 1934

TEMPERATURE UP TO 103

Highest Reading of Summer Reported, With Other Sections Also Suffering From Heat.

While the Arkansas river fell another tenth of a foot at Little Rock yesterday, the temperature climbed to 103 degrees at 4:30 p. m. to a new high record for the year, as readings of 100 degrees or more were reported from many sections of the state where crops already have been damaged seriously by drouth.

The river stage of 3.1 feet below zero at 7 p. m. was a new all-time low water mark at Little Rock. Until the river registered three feet below zero on the gauge Sunday morning, the record low was 2.9 feet below zero, October 1-5, 1931.

Yesterday was the eleventh consecutive day that the temperature has registered 96 degrees or above in Little Rock, and the third day this month it has been 100 or more, the Weather Bureau having reported 102 degrees July 17 and 100, July 18.

The maximum yesterday was the highest in the last three years. The highest recorded here by the Weather Bureau was 108 degrees July 29, 1930. The highest in 1933 was 101, in 1932, 99.6, and in 1931, 102, all occurring in July.

Once the mercury touched 100 degress at 2 p. m. yesterday, it did not go below that point until after 7 p. m., when the Weather Bureau made its last reading until this morning.

Fort Smith reported a maximum temperature yesterday of 104, Memphis, 104, and St. Louis, a new all-time record of 108.

Comments on River Record.

Although the low river mark yesterday afternoon establishes a new record for Little Rock, Harvey S. Cole, meteorologist in charge of the Little Rock Weather Bureau, said there is probably as much water running past Little Rock as in 1897 when the low mark was 1.4 feet above zero, since the river had shortened its course here and dug in deeper, leaving more water below zero on the gauge now.

He said that the river had fallen to within two or three inches of the bottom of the gauge and that if it continues to fall, a marked stake would have to be driven beside the gauge to take river readings.

Low water marks for the past 11 years were listed as follows by the Weather Bureau:

1933	—0.7	1927	2.6
1932	—2.1	1926	—2.3
1931	—2.9	1925	—2.8
1930	—1.4	1924	—2.4
1929	—0.8	1923	0.6
1928	—0.3		

The highest river stage recorded in the Weather Bureau files, 34.6 feet in June, 1833, was measured by William E. Woodruff, founder of the Arkansas Gazette, Mr. Cole said. Mr. Woodruff measured the height of the water above the "Little Rock," located east of the lower Missouri Pacific bridge on the south side of the river, at the highest point of the rock.

Later, United States government engineers took the reading, corrected it to the Weather Bureau gauge set up here, and recorded it as the highest at Little Rock in history.

Makes Drouth Survey.

A drouth survey of the state, compiled yesterday by Mr. Cole, showed that not even a trace of rain had been reported to the Weather Bureau from any part of the state in the last five days. The last rainfall reported was .5 of an inch last Wednesday at Portland.

Little Rock has had no rain since July 17, while Fort Smith, center of the drouth in northwest Arkansas, has had only .15 of an inch of rain in 54 days.

Bee Branch, Van Buren county, has reported only a trace of rain since June 16, and Calico Rock only a trace since June 11. Cotter has had only .20 of an inch since June 11, Jonesboro .34 since the same date, and Pine Bluff only .02 since June 17.

Arkansas City has had only .23 of an inch since June 18 while Newport has had no rain since July 1 and Prescott none since July 3, with other towns in many sections suffering as badly.

The minimum temperature at Little Rock yesterday was 77 degrees, and the mean, 90, nine degrees above normal. Readings for the 24 hours ending at 7 last night were: 7 p. m., 95; 8 p. m., 91; 9 p. m., 89; 10 p. m., 88; 11 p. m., 84; 12 midnight, 81; 1 a. m., 82; 2 a. m., 82; 3 a. m., 81; 4 a. m., 79; 5 a. 77; 6 a. m., 77; 7 a. m., 78; 8 a. m., 82; 9 a. m., 87; 10 a. m., 94; 11 a. m., 96; 12 noon, 98; 1 p. m., 98; 2 p. m., 100; 3 p. m., 101; 4 p. m., 101; 5 p. m., 103; 6 p. m., 101; 7 p. m., 100.

River Entirely Too Low-Down For New Gauge to Be Utilized

Geological Survey Engineer Hopes to Have Contrivance Working Soon.

Gazette July 29, 1934

The Arkansas river played a low trick on Uncle Sam, literally and figuratively.

Last fall the United States Geological Survey built a handsome and expensive gauge on the bank of the river just east of the Main street bridge.

This $2,500 improvement was intended to take the place of the simple $41 slab of concrete which has served the United States Weather Bureau these many years.

But the old Arkansas has fallen so low—down to 3.5 feet below zero, an all-time record—that the modern gauge cannot function. The intake pipe that makes the gadgets go around in the observation room was left high and dry by several feet.

Pipe Being Lowered.

However, that defect is being remedied and the gauge should be in service by this week. Under the direction of J. H. Gardiner, district engineer of the United States Geological Survey, Fort Smith, the pipe is being lowered four feet.

In order to get the pipe down to where it could still draw water from the river, it was necessary to dynamite through several hunks of hard rock.

It should make it mighty nice for Harvey S. Cole, meteorologist of the Weather Bureau, for when the gauge is ready for service, it will be wired to the bureau in the Federal building, and the readings on the gauge will be electrically transmitted.

This will obviate the daily visit to the river bank that has been the custom of Weather Bureau employes for decades.

How It Functions.

The modern gauge consists of a well house about five feet square, extending from the high bluff east of the bridge to the river level. A float is suspended in the well, with a weight to balance it, and a recorder marks the rise and fall of the water on one of those criss-cross charts that abound in Weather Bureau offices.

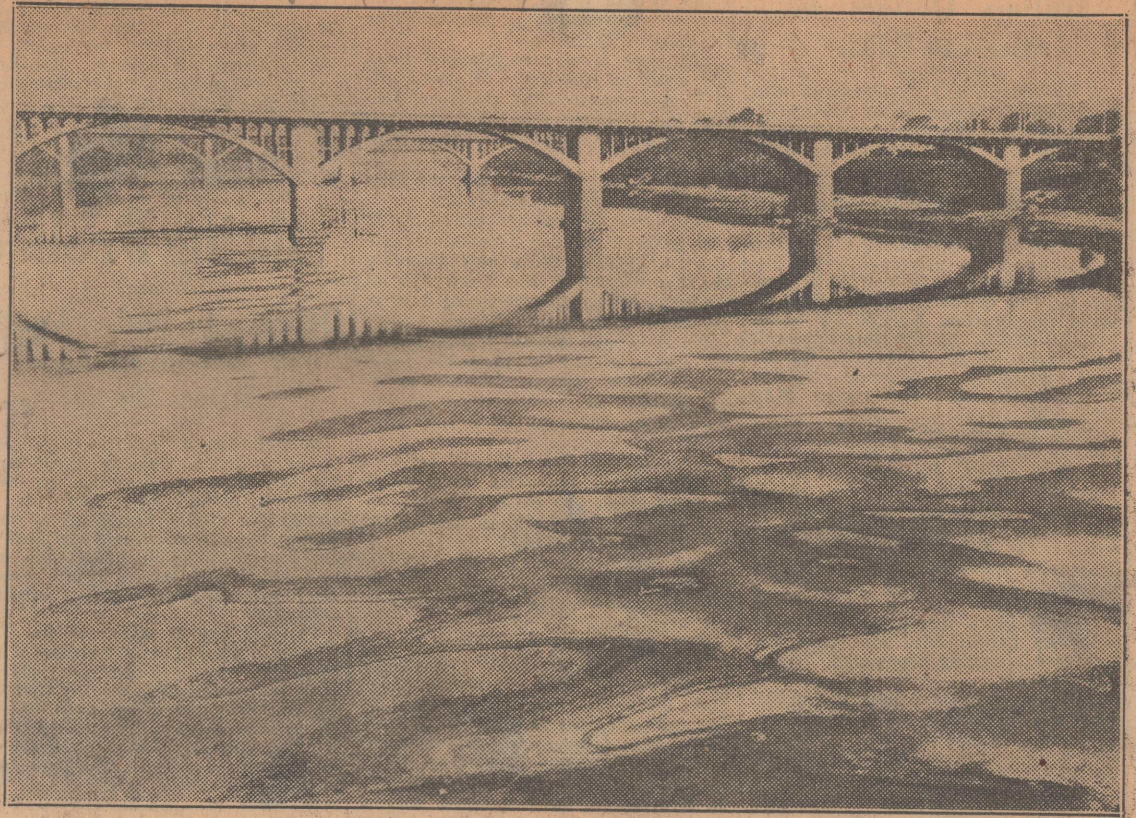
That is, it will, it is hoped, when the well has been sunk as low as the Arkansas river has sunk.

Construction of this and similar gauges in Arkansas was done as a PWA project, for which the Arkansas allotment was somewhere between $30,- and $40,000.

THE NEW RIVER GAUGE.
—Gazette Staff Photo.

Sandbars Fill River Channel

Democrat July 30, 1934



—Democrat Photo.

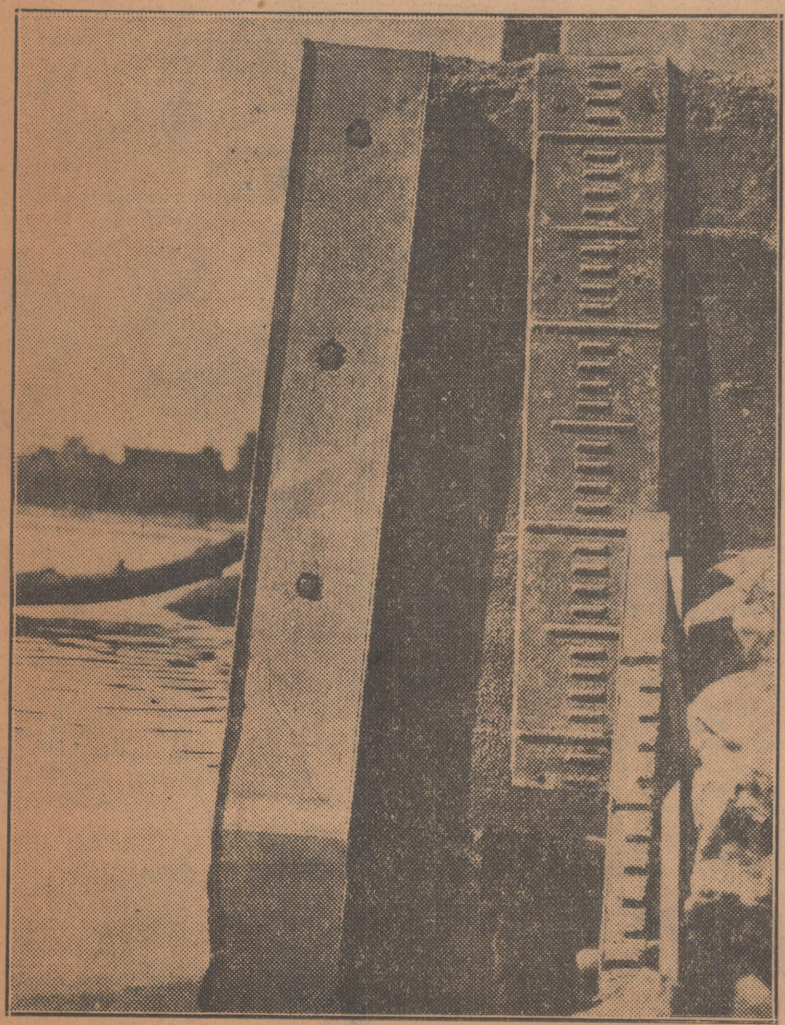
The low stage of the Arkansas river, which now is at a new all-time low, has caused sandbars to pop up at many points in the stream between Little Rock and North Little Rock. In the picture above, a sandbar east of the Main street bridge is shown. The picture w as made from the Missouri Pacific Rock street bridge, looking westward.

The river has fallen to a stage 3.5 feet below zero on the gauge, the lowest stage ever recorded here. The lack of rain in the western part of the state and in Oklahoma and Kansas is responsible for the drop in the water level.

The previous low record was 2.9 feet below zero in October, 1929, while the latest low level has been recorded since the middle of last week.

Arkansas River Has Shrunk Clear Away From Even Low Water Gauge on Bridge

Gazette Aug. 1, 1934



—Gazette Staff Photo.

With the stage of the Arkansas river the lowest in the history of the Weather Bureau here, —3.6, the low water guage on the Main street bridge is high and dry and almost forgotten. An auxiliary guage—really just an unpainted stake with inches marked on it—is the instrument that the Weather Man is now using to determine the "minus" reading of the river from day to day. In the above photograph, the old low water guage, fastened to the pier, is shown riding several inches above the water, while in the foreground is the new guage, almost out of water itself.

They Wade the Arkansas River Here, and Hardly Get Swimming Suits Wet

Gazette Aug. 6, 1934

—Gazette Staff Photo.

The once-powerful and dangerous Arkansas river, already humbled by the drouth, was subjected to further humiliation yesterday when two youngsters waded across it, and hardly got wet. The boys, Warren Bray (left), aged 13, son of Mr. and Mrs. W. C. Bray, 1508 Scott street, and Ralph Middleton (right), 14, son of Mr. and Mrs. A. N. Middleton, 2117 Rock street, paused near the Little Rock side of the river for this picture to be made, after they had strolled across to North Little Rock and then walked back. The water was ankle deep at most places, and at no point was it more than waist deep. They started their walk from near the foot of Foster street, which is in the east end of the city.

Measuring a River's Value

Engineers Say That Basic Records on Arkansas Streams Are Necessary if They Are to Be Developed. Compiling This Information Is Interesting Work.

By EDGAR CHESNUTT Gazette - Dec. 16 - 1934

There is a very definite and yet somewhat indescribable fascination about a stream of running water. The babbling brook stirs the poet to unchallenged heights of inspiration; the roaring river lends a colorful crescendo to the lyrics of the song writer.

But aside from the aesthetic, rivers and creeks have a definite practical value. For centuries man has used them to transport his worldly belongings, has harnessed their hurrying energies to turn mills or generate power for other purposes.

The practical value of the rivers and streams in Arkansas has never been estimated; the only available data regarding their hidden wealth has been gathered to a large extent in a haphazard manner. At no time has complete information been obtained on any one stream and on most of them there is no record available at all. It did appear for a while—after the disastrous flood of 1927—that enough interest had been aroused to assure a complete study, but this work was discontinued by the state in 1933.

Measurement Essential.

Since it seems evident that reliable information on the flow of the river and streams of Arkansas should be secured now, let us see what is involved.

Engineers say 40 river measurement stations are needed, located at strategic points on the various streams for which there is a potential water use or other need for knowledge of flow. Data secured is published in the form of daily discharge in cubic feet per second and applies for a considerable length of the stream in the vicinity of the station location. The records should be continuous for at least 10 years and preferably for 20 or 50 years, adequately to cover all cycles of flow in seasonal and periodic changes. Such a program is carried on by co-operation with the federal government, the work done by competent, trained hydraulic engineers of the Water Resources Branch of the United States Geological Survey, an agency with a 45-year-old reputation for thorough and reliable work which has the confidence of the entire nation.

Engineers Specialists.

The engineers who perform this work must be thoroughly grounded in a knowledge of hydraulics and engineering and for this reason all such employes are required to have an engineering degree from a recognized college or university in addition to passing a rigid Civil Service examination. They do all the field and office work.

Data is secured by the establishment of a gauge on a stream at a point where the flow is to be determined. Gauges are of two kinds. One the staff or weight-gauge, is read morning and evening by a local man or woman referred to as an observer. The observer is selected for honesty and intelligence and a small monthly sum is paid for such service. The second, the water stage recorder gauge produces a continuous record of flow. It is an instrument housed above a tower or well, constructed on the bank of a river, or attached to a bridge pier. The water in this well operated a float which acts on the recorder above to record the river stage on graph paper. This paper is pushed under a pen by a clock, recording a continuous stage for time and height of water.

Initial Cost Largest.

Although more expensive initially, it is obvious that the water-stage recorder record is more valuable and desirable than a gauge read twice a day by a local observer. To translate this record into discharge, an engineer visits each station frequently and makes a discharge measurement with his current meter by taking soundings and meter velocity observations across the stream. He determines his area of cross-section and his velocity of flow for a particular river stage. The area multiplied by the velocity gives him his discharge for that stage.

Many technical problems are involved, both in the office and field work, so these engineers must have a thorough knowledge of their work.

In addition, they must be physically strong, for a discharge measurement takes from two to four hours and involves the handling of sounding weights, weighing from 15 to 50 pounds by hand, and from 50 to 100 pounds by boom and reel. Try careful meter placing and raising and lowering 30 pounds through 40 feet of water at definite points across a stream for two or three hours in any kind of weather, jump into a car and drive 50 miles to another station and repeat the operation, and you will agree it's no snap.

Brave Hazards.

These engineers are required to know how to swim; accidents happen and they have to act fast to keep from being spilled into the river, and to be able to swim out if caught. Once an engineer had a hazardous experience when measuring from a cable. A measuring cable is erected by design and for a sag such that when loaded with a car, men and equipment, the loaded elevation is definitely known. On an older installation and at stage higher than any experienced, this engineer underestimated his clearance with the result that in midstream the river caught the bottom of the car and whipped it downstream.

The cableway tightened and snapped the car back upstream where the water again caught it. This unpleasant experience was repeated several times before the engineer managed to haul himself clear. Heavy logs sometimes will snag the meter line. If unable to throw this drift clear the engineer may have to cut the line to save himself from being pulled into the stream. As this means a loss of about $100 in equipment, there always is a hard fight waged before cutting free.

All instruments used in this work have been developed by or at the instigation of the United States Geological Survey. The work is handled from district offices, of which there are now 37 in the United States and Hawaii. The office for Oklahoma and Arkansas is located geographically at Fort Smith. Considerable work is now being performed in which the federal government has a main interest and is operated purely on federal funds. Much of the work needed in the state is not touched because no state funds are appropriated. Such an appropriation will be matched dollar for dollar by the federal government, but until made the records needed by the state, its engineers and investors, and its cities and institutions, will not be provided.

Reasons for Disinterest.

There are several reasons that might be advanced for a lack of general interest in the subject of river measurement. The first in all probability is that the public is not in direct contact with the rivers and their value. "What practical value can there be in knowing just how fast and how much a river is flowing at a certain point?" the average layman would ask. What then, is essential to assure the work? On the very surface it is evident that those directly associated with river measurement work and its value should present the subject, educate the public to its practicability, and then insist upon its being carried out.

Examples of Value.

There are so many concrete examples of the value of a complete record of river measurements in Arkansas that argument based on them should be far more impressive than any opposition that might be put forward. The great hydro-electric dams on the Ouachita near Hot Springs, Remmel and Carpenter, never could have been constructed without a comprehensive knowledge of the energies the river offered. Capt. Flave Carpenter of Arkadelphia, the man who conceived the idea of the dams, spent a good part of his life in the study of this river, and in 1922 the Water Resources Branch of the United States Geological Survey was brought into the picture to secure reliable unbiased records of stream flow.

It was their combined facts and figures, presented to Harvey C. Couch that resulted in the construction of the present dams and the planning of still a third. This data also provided for the recreational resorts of Lake Hamilton and Lake Catherine to be pictured exactly long before they came into existence.

St. Francis Valley Profits.

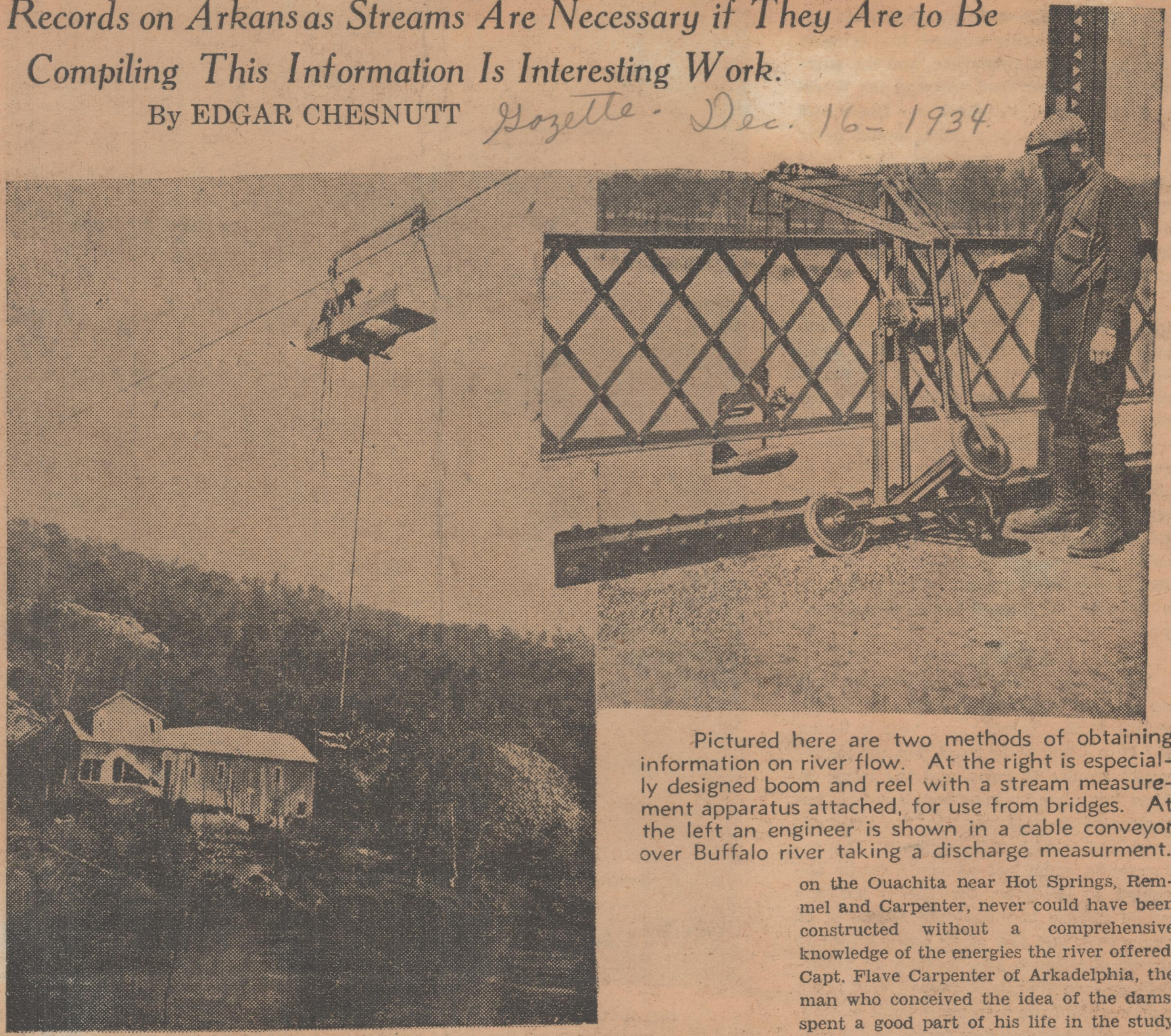
Another example of the practical value of records of stream flow is seen in the St. Francis river basin; because data was available on which to make calculations and surveys, a new levee system was constructed to afford flood protection and greatly improved navigation on the river.

The saving of $100,000 on a water supply project in Crawford county, because the sponsors had facts on which to plan, in itself would carry on the stream measurement work in Arkansas for 20 years.

Right now development of White river's resources looms as a near reality. When this development does come it will be because for nearly 30 years a systematic study and survey of this stream has been under way by Capt. Charles L. LeVasseur, a French engineer of note, who was fascinated by this picturesque stream in 1904 and has been living his life along it since. The fact that he has been retained as engineer while the power rights on the upper reaches of the river have passed from first one to another company clearly indicates that his knowledge is valuable. Of course, if done systematically and under the proper supervising agencies, such studies could be greatly shortened and widened in scope.

During the last six years the levee system of Arkansas has been revised almost in its entirety. Dykes have been raised at

(Continued on page 11.)



Pictured here are two methods of obtaining information on river flow. At the right is especially designed boom and reel with a stream measurement apparatus attached, for use from bridges. At the left an engineer is shown in a cable conveyor over Buffalo river taking a discharge measurment.

Measuring a River's Value

(Continued From Page 1.)

some places, moved back at others, completely eliminated in others and new loop levees built. This program has been carried out by both local levee districts and the United States government.

None of this work, which served the dual purpose of furnishing employment to thousands and increasing flood protection, could have been done without records showing what to expect from the river when the next big rise occurs.

These examples of definite, concrete benefits should be conclusive enough in themselves to show an actual need for such knowledge. But, there is another side of the picture, a view that makes the progressive steps already taken seem actually backward when it is noted what was not done because of a lack of records.

Lack of Data Costly.

One of the most expensive features noted so far, and which can be traced directly to a lack of river information, is bridge building. More than one case is on record where bridges—and expensive ones, too—have been twisted and torn into tumbled masses of concrete and steel because they were built sufficiently high to cover the flood stage, but with insufficient openings to carry the quantity of water that had to flow under them.

There is no estimate of how much money has been spent uselessly in small power dams which were constructed with a mere guess as to the water available; but suffice it to say that those who are in a position to know declare the sum is enormous.

Probably the most striking example of the cost of not having data, was brought forth by the drouths of 1930 and 1934. Cities and towns were forced to turn to new sources of supply for their water. And where were they to turn? Nowhere was there records to consult; surveys were necessary, and such undertakings are expensive when conducted individually. Many communities have felt the absence of water supply information keenly since the Roosevelt administration was inaugurated, since innumerable PWA loan applications for projects have been refused because of a lack of this information.

Selection of the Tennessee valley for the development of power and industry and new living conditions, came primarily because Tennessee, as the result of 15 years of thorough investigation, had compiled complete data on its rivers.

Arkansas Resources Undeveloped.

Some engineers have estimated roughly that the potential power development in Arkansas is 10 times as great as that already developed. Since a substantial part of the activities of the New Deal relates to the development of hydraulic projects, they point out that Arkansas, to realize any benefits from this program, should be prepared to take advantage of the first opportunity that avails itself.

This raises the question of cost to the state for river measurement work. Authorities declare that only $10,000 per year would be required to cover the state properly. The federal government, through the Water Resources Branch of the Geological Survey, would defray half the cost, leaving only $5,000 for the state to pay.

The data compiled by this survey would be published annually by the federal government in a volume with a national circulation and accepted as a source of reliable information by engineers and investors everywhere.

River flow studies, it may be pointed out, do not deal primarily with features that are products of past events and which can be investigated at any convenient time, but deal with forces now operating and producing changes affecting every day life. These forces involve hydraulic work along the lines of flood control, city water supply, industrial usage, sewage disposal, stream pollution, navigation, development of power resources, and court disputes on water rights and damages.

Weather Bureau Adds Water Evaporation Measurements To Its Many Other Duties

Democrat 11-2-36

With installation of a water evaporation measurement station at Russellville and installation of another soon at Hope, the Little Rock Weather Bureau in the near future will be able to give additional information regarding stream flow, run-off from reservoirs, losses of water in irrigation and in soil conservation. The records of the two stations will be published with those of a station at Stuttgart which has been in operation seven years.

H. S. Cole, meteorologist in charge of the Little Rock Weather Bureau, yesterday told of the advantages to be obtained from observations at evaporation measurement stations and said many engineers, business men and farmers desired the information so as to determine amounts of water lost and amounts of water needed in various operations. Records of evaporation also will enable the Weather Bureau to make a more accurate forecast of river stages and stream flow.

One of the stations has been in operation seven years at the Rice Branch Experiment Station, nine miles east of Stuttgart, through the co-operation of the Agricultural Extension Service, although no records obtained there have been published. A private station has been in operation a year at the Freudenberg reservoir, six miles northeast of Stuttgart. Both stations have been in operation in conjunction with problems of rice growing which requires large amounts of water.

A station was put in operation September 9 at the Ozark Nursery of the Forest Service at Russellville and one is to be operated as soon as installed at the Fruit and Truck Branch Experiment Station of the Extension Service at Hope. The station at Russellville is a mile north of the town and at Hope will be about a mile northeast. The latter is expected to be placed in operation within a week.

The measurements taken at the various stations will furnish practical information as to the relative amounts of evaporation in different parts of the country with a record of the wind velocity and meteorological elements usually recorded, Mr. Cole said. In order to obtain the necessary information relating to the amount of evaporation on large bodies of water, percentages will be computed that will provide the desired result.

In computing water levels and run-off in reservoirs, the results obtained from evaporation measurement stations will be of value, Mr. Cole said. By comparing the rate of evaporation under certain weather conditions, it will require little effort to learn the total amount of water evaporating from large bodies.

In irrigation, particularly in rice production, the tests will show the amount of evaporating from the fields and the amounts of water needed to provide proper moisture in the ground.

In forecasting stream flow and river stages, evaporation must be taken into consideration in predicting certain stages and actual measurements on small bodies of water are expected to mean proportionate losses by evaporation on rivers.

The information also is expected to be of benefit in soil conservation work, to tell of water lost and water needed in proper cultivation of the soil and building up of soil.

In order to make the measurements uniform, the stations are similar in size and contain the same type of instruments. The materials needed are an evaporation pan, still well to measure the water, rain guage, anemometer and thermometers. The Hope and Russellville stations are to be exactly alike.

The evaporation pan is 48 inches in diameter and 10 inches deep and is made of galvanized iron and placed on a small platform near the ground, so as to have the water near the level of nearby water. The anemometer is located four inches above the top of the pan to measure the wind movement and the rain guage and thermometers are located nearby to measure rainfall and maximum and minimum temperatures.

The measurements of water in the evaporation pan are made by means of a hook guage in a still well and are made in hundredths of an inch. The still well rests in the pan with the hook guage inside and operated by a screw to the proper water level.

The hook guage extends into the water when the height is measured withdrawn slowly until the point of the hook just breaks out of the water when the heightis measured by means of the guage attached in the still well.

Records of evaporation are taken at the same time each day to give regularity to them. The maximum and minimum temperatures during the 24 hours, time of beginning and end of rainfall, character of the weather during the daylight hours, such as clear, partly cloudy or cloudy; the wind movement and direction of wind are included with the evaporation guage reading. The amount of evaporation is determined by subtracting the height from the reading of the previous day. If rain has fallen, the amount of rain is added and the reading subtracted, still resulting in the amount of evaporation.

Evaporation measurements have been conducted in various parts of the United States for several years, Mr. Cole said, and with the three stations in Arkansas and possibly a fourth, monthly and annual amounts will be published hereafter in the annual climatological summary of the state.

The record at Stuttgart is to be published soon and the record at a station at West Memphis conducted for a year in 1931 and 1932 also will be published. Summaries and reports of the officials in charge will be included with the evaporation figures and comments on weather conditions.