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HARRY F. BLANEY:

WATER CONSERVATION ENGINEER

Completed under the auspices
of the
Oral History Program

University of California
Los Angeles
1969

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ILLUSTRATIONS

[The frontispiece and the photo of Wayne D. Criddle are not contained in Copy 2.]

INTRODUCTION

Harry French Blaney, winner of the John Deere Medal, is a native Californian, born in Los Angeles on July 19, 1892. He received his B. S. degree in civil engineering from the University of California in 1915, where his studies included irrigation, hydraulics and soils. After graduation he accepted a position as an engineer with the Southern California Gas Company, and in May of 1917 began a career with the United States Department of Agriculture, Agricultural Research Service, that continued until his retirement in 1962. He then took up his present duties as research associate in the department of irrigation and soil science at the University of California at Los Angeles.

He was honored for superior service by the U. S. Department of Agriculture, and in 1961 received a Distinguished Service Award from the California Chapter of the Soil Conservation Society of America. He Is perhaps best known as senior contributor in the development of the "Blaney-Criddle Formula" for calculating water loss by evaporation, and evapotranspiration by plants.

Blaney is the author or co-author of scores of published works on water use, rates, and requirements, and irrigation. He Is a member of seven scientific societies, and i 1954 was a delegate for the National Academy of Sciences and National Research Council to the Tenth General Assembly of the

International Union of Geodesy and Geophysics in Rome, Italy.

This interview was conducted under the auspices of the Water Resources Center at UCLA as one of a series dealing with the history of water development in California and the Southwest.

Records relating to this interview are located in the oral history office.

BIO-BIBLIOGRAPHY

Name: Harry French Blaney
6407 Maryland Drive, Los Angeles, California 90048
Date of Birth: July 19, 1892. Place: Los Angeles, California.
Education: Los Angeles Polytechnic High School, 1907-11.
University of California, 1911-1915, B. S. in Civil Engineering, 1915 (irrigation, drainage, and soils).

Organizations:

1. Irrigation Engineer, U. S. Department of Agriculture, 1917-1962.
   a. Office of Irrigation Investigations, 1917-31.
   b. Bureau of Agricultural Engineering, 1931-39.
   c. Soil Conservation Service, 1939-54.
   d. Agricultural Research Service, 1954 until retirement January 1962.
2. University of California at Los Angeles
   a. Research Associate, Department of Irrigation Research and Soil Science, January 1962-July 1965.
   b. Department of Engineering and Water Resources Center, July 1965 to date.

Professional Record:

Sep 1915-Apr 1917	Engineer So. California Gas Co., Los Angeles.
May 1917-May 1918	Agent, U. S. Department of Agriculture, Irrigation and Silt Studies, Colorado River and Imperial Valley in California, and Mexico.
May 1918-Dec 1918	Master Gunner, Non-commission Staff Officer U. S. Army.
Jan 1919-Jan 1962	Irrigation Engineer, U. S. Department of Agriculture in California and other areas as follows:
Mar 1919-Dec 1919	In charge of Denver Irrigation Field Laboratory, evaporation and evapotranspiration studies.
Dec 1919-Jan 1927	Studies of sedimentation in Imperial Valley and Colorado River; cost of irrigation water; and evapotranspiration in cooperation with State of California.
Jan 1927-Jul 1934	Consumptive use of water by irrigated crops and native vegetation and rainfall disposal in cooperation with the State of California at Los Angeles
Jul 1934-May 1935	Water conservation engineer, developing water for drought areas, New Mexico, cooperation with Federal Emergency Relief Administration, Santa Fe, New Mexico
Jun 1935-Apr 1936	Water utilization studies, Mojave River, and irrigation, California.
Apr 1936-Mar 1937	In charge of consumptive-use studies, Upper Rio Grande, for National Resources Committee, Colorado, New Mexico, and Texas, Albuquerque, New Mexico.
Apr 1937-Dec 1939	Water utilization studies, Beaumont and San Jacinto Basins and San Fernando Valley, California.
Dec 1939-Jan 1941	In charge, consumptive water requirements, Pecos River Joint Investigations, New Mexico and Texas, National Resources Planning Board and U. S. Soil Conservation Service, Carlsbad, New Mexico.

Jan 1941-Apr 1941	Member of technical mission to Cuba to investigate rehabilitation of agriculture, 12 dam sites, soils, and water supply for rice irrigation, Havana, Cuba, and Washington, D. C. for U. S. Department of State.
Apr 1941-Jan 1942	Water Utilization Studies, San Luis Rey Valley, in cooperation, State of California.
Apr 1941-July 1941	Irrigation and water supply studies, Soil Conservation Service, Los Angeles, California.
Jan 1942-May 1943	In charge, irrigation surveys on quantity, quality and cost of water in southwestern states of Guayule Rubber Project, Forest Service, U. S. Dept. of Agriculture.
May 1943-Jan 1951	Project Supervisor, consumptive irrigation requirement studies in Arizona, Colorado River Basin, and Pacific Southwest; and drainage studies in Imperial Valley, California.
Jan 1951-Jan 1954	State Research Supervisor, in charge of cooperative irrigation studies with the State Engineer of California and U. S. Soil Conservation Service.
Jan 1954-Mar 1959	Principal Irrigation Engineer, U. S. Agriculture Research Service, in Pacific Southwest.
Mar 1959-Jun 1959	Irrigation Engineer Consultant in Israel for U. S. Department of State, International Cooperation Administration.
Jun 1959-Jan 1962	Principal Irrigation Engineer, U. S. Agricultural Research Service, in Pacific Southwest.
Jan 1962-Jul 1965	Research Associate, Dept. of Irrigation and Soil Sciences at the University of California, and Collaborator, U. S. Dept. of Agriculture.
Jul 1965 to date	Research Associate, Dept. of Engineering and Water Resources Center, University of California, Los Angeles.

Consultant (Registered Civil Engineer, State of California):
For the State of California and other agencies on litigation of the use of water from the Colorado River, 1956-58; For International Boundary and Water Commission, U. S. Dept. of State on Salinity in Lower Colorado River, Jan. 1962; For 20 farms, Gila River Basin, New Mexico, 1963-65; for State of Arizona on water use in Central Valley Project, Jan. -Feb. 1966; and consumptive use on farms in Colorado, Jan. -Nov. 1968.

Memberships in Scientific Societies:

1. American Society of Agricultural Engineers, 1950-1968. Past member of Evapotranspiration and Nomenclature Committees.
2. American Society of Civil Engineers, 1920 to date. Fellow and Life Member; Past vice-president Los Angeles Section; Past chairman of National Executive Committee of Irrigation and Drainage Division; Past member of Committee on Sedimentation of Reservoirs and the Hydrology Sub-committee; Past chairman Committee on Water Conservation; chairman Committee on Consumptive Use of Water and member of Publication Committee.
3. The Society of Sigma Xi, 1951 to date (Calif. Institute Tech. Chapter).
4. United States National Committee of the International Commission on Irrigation and Drainage, 1952-1960.

5. Soil Conservation Society of America, 1946-63.
6. American Geophysical Union, National Academy of Sciences, National Research Council, 1932 to date, Life Member. Delegate for the National Academy of Sciences and National Research Council to the Tenth General Assembly of the International Union of Geodesy and Geophysics, Rome, Italy, Sept. 1954. Past member of Evapotranspiration, Infiltration and Ground-Water Committees. Past secretary and vice-president of Hydrology Section.
7. Pacific Southwest Inter-Agency Technical Committee, member of Subcommittee on Phreatophytes.

Honors and Awards:

Superior Service Award and Silver Medal; U. S. Dept. of Agriculture, 1951.
Distinguished Service Award, California Chapter, Soil Conservation Society of America, 1961.
The John Deere Medal, American Society of Agricultural Engineers, 1966.
Royce Tipton Award, American Society Civil Engineers, 1966.
Service Award—Member for 28 years, Agricultural Committee, Los Angeles Chamber of Commerce.
Honorary Member, Greek Committee of International Commission on Irrigation and Drainage.

Publications:

Author or co-author of about 170 reports on the subjects of consumptive use of water (evapotranspiration) by irrigated crops and native vegetation irrigation, evaporation, water supply, utilization of water, cost of irrigation water, drainage, salinity, water conservation, ground water and sedimentation.

These reports are listed in Addendum to the Oral History of California Water Resources Development by Harry F. Blaney Research Associate University of California, Los Angeles

INTERVIEW HISTORY

INTERVIEWER: Donald J. Schippers, Interviewer-Editor, Oral History Program, UCLA. Age 35. B. A. American History, UCLA, M. A. American History, Occidental College.

TIME AND SETTING OP INTERVIEW

Place: Office of Harry Blaney, Engineering Building, UCLA.

Dates: October 14, 21 and 28, 1963.

Time of day and length of sessions, and total number of recording hours: Each session lasted approximately one and a half hours, during which one hour of Interviewing was recorded. The interviews were conducted in midafternoon. This manuscript represents a total of three hours of recording time.

Persons present during interview; Blaney and Schippers.

CONDUCT OF INTERVIEW: The interviewee was encouraged to give a chronological account of his career and to comment on various professional associations. The tape recorder was stopped frequently during the interviews, but questions asked during these pauses were restated when recording was resumed.

EDITING: Editor: Donald J. Schippers.

In 1965, a verbatim transcription of the tapes was made. Punctuation was Introduced and syntax emended only slightly. On reviewing the transcript, in the interest of factual accuracy the interviewee made extensive changes, adding a great deal of new material and striking much of the original account. This manuscript, therefore, represents a careful and almost complete rewriting of the original transcription.

BIBLIOGRAPHY. see addendum.

Family History

Blaney: My name la Harry French Blaney. I was born July 19, 1892 in Los Angeles, California. My father, Henry C. Blaney Immigrated to Los Angeles from Ottawa, Canada in 1888 and his father immigrated to Canada from Northern Ireland. My father went into the shoe business with his uncle in Los Angeles, Later it became the H. C. Blaney Shoe Company for twenty years until the depression of 1911 when it was liquidated, and he went into the real estate business. During the depression the banks called in all the gold coin and paper money and replaced it with script.

My mother, Hattie French Strong, was born in Vergennes, Vermont near Lake Champlain. She was a descendant of General French. She migrated from Boston to Los Angeles in 1889 with her father, mother, sister and brother.

My mother and father met in the First Methodist Church in Los Angeles and were married there in 1890. At ten years old, in 1902, I used to ride on the horsecar to see my cousins who lived near the University of Southern California and played along a canal, adjacent to Figueroa Street, which irrigated vegetable fields near Exposition Park. At that time moat of city travel was by cable cars.

My father did not go to college, but my mother went two years to the normal school for teachers at fifth and Olive in Los Angeles.

In 1983 I married Margaret E. Clay, and we have two

sons: Harry F. Blaney, Jr., who spent two years in World II, graduated at Utah State University, and is sales engineer for a steel company; and Robert W. Blaney, who was in the Korean War, graduated from UCLA, and received a Doctors at the University of Boston. He is now Associate Professor at the Pacific University, Stockton, California.

Early Education

When six years old, I started in first grade at the Sixteenth Street Grammar School, and in 1907 entered Los Angeles Polytechnic High School. James Francis was the principal. This was one of the first technical high schools in the United States, patterned after technical schools in Germany. Later he became superintendent of Los Angeles Schools.

Since my father and mother did not go to college, they encouraged me to take all high school courses required to enter the College of Engineering at the University of California at Berkeley. The courses included four years of mathematical one year of chemistry, physics, mechanical drawing, and workshop; two years of English; and four years of French. An engineer living next door loaned me some engineering books.

Another thing which interested me in taking Civil Engineering was a book on the experiences of a Civil Engineer who was an observer in a balloon during the Civil

War, 1064-67. The balloon was blown off its course in the United States and he landed on a desert island in the Pacific Ocean. As a result of his engineering training, he was able to survive and develop technical devices which enabled him to live comfortably until several years later when he was rescued from the island.

While at Polytechnic High School, I was a member of the glee club and sang in the musical opera. The Pirates of Penzance. Also for four years I was a member of the Boys Choir of the St. Paul Procathedral which was located on the westside of Olive Street between Fifth and Sixth Streets where the Biltmore Hotel stands today. Every year the choir spent a week at Avalon, Catalina Island and gave several concerts at the Bandstand in the evenings. I graduated from High School in June, 1911 with college recommendations.

Activities at the University of California

When I entered the four year engineering course in Civil Engineering in August, 1911, I majored in irrigation, drainage and hydraulics.

As previously stated, in 1911 there was a depression in California. As a result my father's shoe store went into bankruptcy and he started a new profession of real estate with very little money. However, he was able to give me one hundred dollars to enter the college of engineering at the University of California at Berkeley.

ship Hanale. The ship engines stopped off Monterey. After a delay of one-half day for repairs, I arrived in San Francisco at midnight, two days after leaving Los Angeles. A ferry took me from San Francisco to the Oakland Mole, where I boarded a Southern Pacific Steam train for Berkeley in August, 1911.

After registering in the College of Engineering for a four year course, I went to the University YMCA to look for a room. There I met a senior Civil Engineering student who was transferring from another college. We located a room in a private home for ten dollars per month (five each). We had our meals in a nearby cafe at a cost of about one dollar per day.

After paying for the cost of my trip to Berkeley, an Army cadet uniform, textbooks and laboratory fees, I had about twenty-five dollars left for room and meals.

However, since I had worked in my father's shoe store during vacations in my high school days, my father gave me a letter of introduction to the Manager of the Walk-Over Shoe in San Francisco. There I earned from five to six dollars each Saturday working from 8:00 a.m. to 10:00 p.m. This was a supplemented by a cheek of fifteen dollars per month which my father sent me. This continued during the first three and one half years of my college carreer. The last six months my father gave me $250 he borrowed so that

I could finish my thesis, The Comparison of the Cost, the Life and the Capacity of Wood-stove, Steel and Concrete Pipes.

Schippers: What was the reputation of the University of California at Berkeley as far as agriculture and irrigation courses were concerned?

Blaney: Well, there were 5,000 students when I attended the University and there were about 1,000 in my class of 1915. Benjamin Ide Wheeler was President. The University of California had an excellent reputation. It was one of the few universities that gave a course in irrigation and drainage engineering. Other good courses were hydraulics and mechanics. The College of Agriculture didn't have such a good reputation among the engineers, because it was referred to as Cow College, and moat of the athletes were in the College of Agriculture because of the easy courses given.

call the pipe courses in horticulture, and botany in agriculture, However, we had to take a course in soils, and Professor Lippman who gave this course was very much disturbed by the fact that the engineers called the Agriculture College the Cow College, So he made his course in soils about as hard as any courses we had in engineering.

During that period the dean of civil engineering was Charles Derleth, Jr. He graduated from Columbia University in structural engineering. He was entitled to do consulting

work, and he had been consultant on the rebuilding of San Francisco after the 1906 earthquake. He designed the campanile tower on the campus, and when we were in his class in structural engineering, we checked the designs. Later on, he was consultant on the Oakland-San Francisco Bay Bridge. At that time, a professor in Engineering was allowed to do consulting work because their salaries at the University were very low. In fact, several professors had larger incomes from consulting work than they did from University salaries.

Schippers: Who were some of the other professors you had?

Blaney: One of the best professors I had was in the College of Mechanics. He was little Joe Le Conte, and if you took good notes in his class (it was a difficult course in hydra-lics), you were able to pass the examination very easily without too much studying because he was able to put across hard subjects, including the practical application of calculus to hydraulic design, so that most of the students understood it providing they took good notes.

In contrast to this. Professor Charles Oilman Hyde, in the College of Civil Engineering, gave a rather hard course in hydraulics. And if you didn't pass the final examination, you received a condition and had to retake the final exam-ination, which I had to take in ray Junior year, although my weekly reports were above average. I had several courses in irrigation and drainage with Professors B. A. Etcheverry

and S. T. Harding, and Charles Derleth, Jr. All were excellent engineers with practical experience.

During my stay at the University I Joined a male quartet, and once or twice a month we sang at different prisons surrounding the bay area--Alcatraz the federal prison, and San Quentin, the state prison.

Schippers: How did you happen to major in irrigation and drainage?

Blaney: Well, the other major courses in engineering at that time were railroad, structural, municipal and sanitary engineering. Then irrigation development in California and the west was well under way and I thought that such an education would give me more time on field work, than some of the other engineering degrees. During my sophomore and Junior years, I attended summer University Surveying Camps near Santa Cruz, where I learned to layout irrigation canals and measure water.

Schippers: In other words, you would say that California needs and the curricula offered in the University had a close connection with irrigation and water supply.

Blaney: Yes. Of course, you know that at the present time, starting about 1958, most of the courses in irrigation were transferred from Berkeley to the University of California at Davis. After the death of Professor Etcheverry, Professor Russell Simpson, who had been a supervising engineer in the

California State Department of Water Resources, was appointed head of the irrigation department at Berkeley in the early '50's, But before he could get courses in irrigation and hydrology well started, he passed away and no one with sufficient training in irrigation engineering took his place. Later most of the irrigation engineering courses were given at the University of California at Davis.

later became president of the University, was in the senior class when I was a sophomore. He corrected my surveying papers.

In my junior year, during the summer vacation, I had a job with two other college students in laying out a subdivision at Richmond, California. The lower part of the subdivision was in rectangular lots which were very easy to survey, while the upper part was rolling hills. We computed and put in the center lines of streets which were on many curves, somewhat similar to what Berkeley streets are today and similar to the subdivisions in Beverly Hills, We computed the dimensions of irregular curved-size lots, and we planned to stake out the lots later during the weekends in our senior year.

The real estate promoter, though, didn't wait for that. He sold the lots to sailors and schoolteachers all over the United States, and he didn't think it was necessary for us to lay out the lots that were irregular in size. Before we could negotiate with him and explain the situation, he died.

Today those lots are still there. They were never staked out and the streets were never put in. Although we filed a map with the county recorder in 1914, you didn't have to show that the lots and curved streets had been staked.

One of the traditions of the University was for the freshmen to wear green caps, the sophomores red caps, and the juniors and seniors stetson hats. The sophomores initiated the freshmen by taking them on a night tour of the famous China Town and Barbery Coast in San Francisco. This was an experience to a green freshman.

While in college I was offered five dollars to distribute literature against the reelection of a Mayor for San Francisco who was being opposed by a prominent businessman. I rented a room in a rooming house the night before, near the polling place. When I started to distribute the literature next morning at six o'clock, I was surprised to find that there were saloons on three corners and an Italian winery on the fourth comer near the polling place. Also the girls from the Barbary Coast were out in full force pulling for the incumbent Mayor, and they tried talk me out of distributing the literature. However, I convinced them I was working my way through college. A new Mayor was elected and the Barbary Coast was closed by the Redlight Abatement State Law.

The 1913 World Exposition was opened in San Francisco in my senior year. We were called the Exposition Class of

1915. Our graduation was held in the Greek Theater in May, 1915, and I received the degree of BS in Civil Engineering. My diploma was signed by Benjamin Ide Wheeler, President of the University and Hiram W. Johnson, Governor of California.

At that time, one of the university traditions was that the senior men were supposed to wear straw hats and tour the campus. But it rained so hard that this tour was given up. However, our senior extravaganza, was given in the Greek Theatre, was well attended with people holding umbrellas or wearing raincoats. A canopy of canvas put over the stage became so full of water that we had to shoot holes in it to prevent it from collapsing. The extravaganza was continued to the finish. The rain stopped for a while so I attended the Senior Ball which was a formal affair. The rain started again and since no taxi was available we went home in the rain. Rainfall records were broken that month. I stayed a few days in Berkeley and of course I visited the San Francisco 1915 Exposition before returning to Los Angeles.

My First Jobs

Upon my return to my home in Los Angeles I found, owing to the fact that World War One had started in Europe, that there were no engineering Jobs available. So I went to work for a shoe store for seventy-five dollars a month. After working in the shoe store for about six months and

answering many ads, I was employed by the Southern California Gas Company as office engineer and assistant field engineer at a salary of seventy-five dollars per month to design and lay out gas lines in the City of Los Angeles and the surrounding territory. We made a right of way survey for one of the first welded pipe lines in California from Lynwood to the Fullerton natural gas wells.

After being with the Gas Company for about two years and having my salary raised to eighty-five dollars a month, one of my classmates, Ray Mathew, was offered a job with the United states Department of Agriculture early in 1917 as an irrigation engineer. He decided not to accept the position and recommended me.

Imperial Valley Problems, 1917-18

I visited the Office of Irrigation Investigations of the United States Department of Agriculture in the Federal Building at Los Angeles and was interviewed by C. E. Tait and Frank Veihmeyer. I was offered a job in May, 1917 at 125 dollars per month with headquarters in Calexico, California to work under the supervision of Veihmeyer to make a study of sediment and silt problems in the Imperial Valley in California and Baja California, Mexico, and along the Colorado River from Topock to the Mexican border. Silt samples were from the river in different cross sections.

Also, during the summer of 1917, Veihmeyer and I measured the amounts of water applied to six alfalfa ranches and took soil samples down to twelve feet. The maximum air temperatures reached 120 degrees F.

Schippers: How aware were you of the whole Colorado River problem at the time of your employment?

Blaney: It was a new field for me. Of course, one of the duties of this position was to measure the velocity of the canals and determine the capacity of the canals, and it required taking water samples throughout the cross section of the canal, horizontally and vertically. Courses in the use of current meters and surveying instruments were taken in college and so that was nothing new to me.

There had been considerable work done in India on the game problem, and there, after the silt had filled the canals or settled on the upper part of farm lands when irrigated, they were able to remove it with cheap labor, using baskets. Our problem was to devise some method of eliminating the heavier silt sediment, the bedload as we call it, which came down through the intake of the Imperial Canal and passed through Mexico for about fifty or sixty miles before it entered the United States where the bedload of sand settled into the canal system, as well as finer sediments, and onto the irrigated lands. This required the upper end of the irrigated lands to be releveled about every three years and the many canals to be cleaned at a cost of about one million

dollars per year.

As a result of taking thousands of water samples and setting up eighteen silt stations, along canals, five in Baja California, Mexico and fifteen in the United States, where daily samples were taken by the Zanjeros or gate men, we finally arrived at a solution (see Figure 1). That was to enlarge the water intake from the Colorado River to the main canal through the gates (it went from three large gates to forty-eight smaller gates). These gates skimmed the top of the river water, which contained the finer sediments. * (See Plate 1) And these gates kept out the sandy bedload which was causing so much trouble in keeping the canals in the Imperial Valley and Mexico in shape so they could deliver water to the farmers.

This dredging the silt out of these canals every year gradually raised the banks of canals so they were becoming higher and higher each year and eventually, there would have been a limit as to how high they could go. I think they were rising about six to twelve inches a year.

Schippers: Besides the purely technical aspects of the problem, how aware were you of the legal and political situation?

*For description and photos, see Harry F. Blaney, Silt in Colorado River and Its Relation to Irrigation, U, S, Department of Agriculture, Tech. Bul. No. 67, 1920.

Blaney: Well, at that time there was always a question of bringing the water through Mexico. During World War I, Governor Cantu of Lower California was pro-German and it was rather difficult to work in Mexico, Then Mark Rose, one of the directors in the Imperial Irrigation District wanted to put the east mesa of the Imperial Valley under irrigation, and since there was trouble in getting water through Mexico, in order to avoid that they finally built the All-American Canal so that water did not have to travel for about sixty miles through Mexico, And under the contract, the Mexicans had right to about half the water. That's the way the legislation went through. In fact, the U. S. Bureau of Reclamation published a report called the All-American Canal.

A similar situation occurred on the Rio Grande at El Paso where the diversion work was partly in Mexico and partly in New Mexico, United States, and they couldn't control the amount of water that the Mexicans used which was more than they were entitled to by treaty. So the U. S. built an All-American canal to divert water out of the Rio Grande from the American aide of the line.

course, was really started in the early 1900's by the California Development Company, then they cut the bank in the Colorado River and built a wooden gate to control the diversion, starting at just about the international boundary line and going through Mexico about sixty miles before re-entering California.

The main problem during 1917 and '18 was the roadblocks that the Mexicans put in the way of operating the canal systems in Mexico, Also the District had to, each year, build a temporary brush weir across the river Just above the international boundary line during the low flow of the river, to divert the water into the Imperial Irrigation Canal, Imperial Irrigation District had to put up a bond of a million dollars as Insurance against any damage that raising waters at the dam during flash flood periods of the river might do to the Yuma Valley Project which was built and being operated at that time by the U. S. Bureau of Reclamation.

The year, 1917, was one of the times when the increased river flow did come damage. The Colorado River might have a maximum flow in June and then, along in July or August, the river would be so low that you would have to put in the brush weir to divert the water into Imperial Valley, That was the time when Frank Veihmeyer, then with the United States Department of Agriculture (later with the University of California) and who was supervising my work, asked me to meet him on the Fourth of July in Yuma, to measure the flood discharge of the Colorado River and the amount of the suspended silt load and bedload that was being carried by the river during the flood period. We metered the river and took samples

all day across every ten-foot section and at different depths at the gauging station of the Bureau of Reclamation. And we were marooned above the river in the gauging carrier suspended by a steel cable for about eight hours until we were finally pulled in. Being a holiday, the Bureau of Reclamation of men didn't come back until about five o'clock. But they finally pulled us back by a windlass in this gauging carrier that they used to cross the river in at different intervals to take velocity measurements and so forth,

Schippers: Was the Mexican opposition just to spite the U. S, or did they really feel that they had a real problem in getting enough water?

Blaney: They obtained enough water after this brush weir was constructed. It happened that, since the U. S. was at war then, that the Imperial engineer in charge, who by the way is still living in Glendale, didn't pay attention to the U. S. Army Corps of Engineers who would not let the District use any large boulders to hold this brush dam in place. But Engineer Peck went ahead and dumped enough heavy rock in the dam site so that, in 1917 shortage after the flood, they were able to hold the brushweir, which was suspended on a cable, and get all the water needed,

The main difficulty was that the governor of Lower

[Baja] California, which was a territory at that time, was pro-Germman and made it very difficult in getting supplies across the line.

For example, when I would take pint mason glass jars across the line for silty water samples, they would charge me about twice what it would cost to purchase them in Calexico. So I bought some corks in a drug store and used beer bottles to bring the water samples out of Mexico. And then, of course, immigration and custom authorities in the United States were a little suspicious until they found out what we were doing. But Americans living in Calexico and working in Mexican and the irrigated areas had to pay high duty on the clothes they took with them. Sometimes American cars going over to Mexican had their windshields broken.

In fact, the American ranchers farming in Mexico were given a very bad time and it resulted in even some Mexicans coming to Calexico and having free-for-all battles with Americans. You may know, prior to that, in 1915, before I went to Calexico, a soldier of fortune organized an expedition that went over into Lower California and took Mexican by force and held it for several months. Then the United states allowed Mexico to bring troops through the United States in order to drive the soldiers of fortune out of Mexicali. One of my classmates who was in Calexico in 1915 said they could get up on

the roofs of the buildings in Calexlco and see this battle in Lower California. So in 1915-16 there were these rather hard feelings.

As far as the amount of farm land in Lower California is concerned, it was controlled principally (some 500,000 acres) by General Otis of the Los Angeles Times. And also the Southern Pacific Railroad received land grants from the Mexican government. Some of these lands along their right of way, which was every other section, were leased to farmers in the Imperial Valley who planted large cotton and hemp acreages in Mexicali Valley. This was another reason there wasn't too good feeling between the Mexicans and the Americans.

used a Mexican car when I went across the line. I would make an all-day trip once a week to deliver and collect filter papers that were used to filter the sediment out of the water samples that were being taken daily by the Zanjeros [gatemen] and having a Mexican oar and having a passport, I didn't have any trouble.

But one afternoon, when I was driving out of Mexico, I saw two American soldiers being forced by a troop of Mexican soldiers on horseback to walk into Mexicali. I asked them what the trouble was and they said, "Well, we wish to get in touch with our commanding officer in Calexico, and it seems that one of their officers, a first

lieutenant, had found that agricultural instruments or equipment were being smuggled across the line into U. S., and so they stationed these two soldiers with enough food to last them for a couple of days and asked them to guard this entrance, They got tired of doing that, so they set up some tin cans and began target practice, and much to their surprise, they found they were stationed by their commanding officer in Mexico, I telephoned their officers. They got them out of Mexico all right. There wasn't so much hard feeling between the U. S. Army and the Mexican Army, but the two soldiers were encroaching on Mexican territory. There were many other incidents.

In April, 1917, I applied for a reserve commission in the Engineering Corps of the U. S. Army, and when I went up for examination the district engineer in Los Angeles said, "Well, since you're in the U. S. Department of Agriculture, we will have to have a letter from your supervisor saying that they can spare you from the Department of Agriculture, " My chief from Washington came to California about that time and said the war would only last a short time, and he said I was needed in Agriculture, and he wouldn't give me a letter. So since I had only been in the U. S. Department of Agriculture service for a few months, I decided to stay.

World War I Experiences

However, a year later, in May, 1918, I resigned from the U. S. Department of Agriculture and applied for the Officers Training Camp in the Infantry through the university of California at Berkeley, since I found that because I was registered in the draft, I couldn't enlist in the Navy, the Marine Corps or the Army at that time but would have to wait several months before my draft number came up.

I had to wait about a month in Berkeley, and during that period, I stayed at a French boarding house and brushed up on my French that I had taken in my high school days, doing over to San Francisco one day, I accidentally met one of my classmates who was a captain in the Artillery Corps. When I explained my predicament about trying to get into the engineering or some other technical group, he said, "Well, give me your draft number and I'll wire back to Washington and have you in the service in one week. There's no use going into the infantry, when you can go into the heavy artillery which has more engineering of the kind you want than the Corps of Engineers."

So I went into the noncommissioned staff officers school in San Francisco and took an electrical sergeant's course, and after a few months passed an examination and

was transferred to artillery school at Fort Monroe, Virginia. After passing the electrical sergeant's course, the colonel, the commanding officer of the school, called me in and said he had an order to transfer me to the Engineering Corps if I wanted to go to the officers training camp. He said, "If you do not want to go, I'll put you in the Master Gunner course which is really a civil engineering course, and you'll eventually become an orientation officer in the artillery."

After graduating as a master gunner, a noncommissioned staff officer, I was an instructor for several months; I was transferred to the officers training camp at Fort Monroe, Virginia, which was about a month before the Armistice was signed. Ten days after the Armistice was signed, the commanding officer said, "All those who are under twenty-five can finish the course and go in Reserves as a second lieutenant. Those over twenty-five can become a first lieutenant, and those over thirty can become a captain in the Reserve Corps. Those who want to get out and don't want to finish the course, will let them out immediately." So ten days after the armistice was signed, I was discharged from the candidate officer training camp and was on my way to Washington, D. C. where I spent a week, and then to New York, where I spent three weeks sightseeing and trying to obtain an engineering job overseas on rehabilitation construction

work.

The New Yorkers were very kind to servicemen. For example, while at a church entertainment for soldiers, I met a girl who invited me to dinner at her beautiful home on Riverside Drive, Her father said, "We have two horses—since you are from California, why not take my daughter horseback riding in Central Park tomorrow afternoon." As I had not been on a horse for many years we went to a show instead.

The week before Christmas I decided to return to Los Angeles via Philadelphia and Chicago. When I applied at the Philadelphia Ticket Office with my discharge paper for a one-cent per mile fare to Los Angeles, they said, "You should have applied right after being discharged." However, the ticket agent was kind and sold me a ticket at the reduced rate and I arrived in Los Angeles Christmas Day. The train was late on account of being snowbound in Colorado.

Re-appointment to United States Department of Agriculture

Blaney: Well, in January 1919 I was re-appointed junior irrigation engineer and sent to Berkeley for three months to work with Frank Veihmeyer on summarising all the work that had been done in 1917-18 on soil moisture and irrigation requirements for crops in Imperial Valley. In reviewing this data which had been collected in 1915,

'16 and '17 it was decided, on account of unusual soil conditions found in irrigated farms in Imperial Valley where there was an impervious clay layer and a coarse sand layer in the same foot of samples which were taken down to thirteen feet, that it would be difficult to determine the use of water by analyzing the soil moisture determinations, which included soil moisture fluctuations during the irrigation season, and to determine the moisture equivalent and wilting point of the soils.

In April, 1919, I was transferred to Denver to be in charge of the Denver Irrigation Field Laboratory on studies of evaporation, from water, evapotranspiration [consumptive use] and irrigation requirements of field crops. (This station had been shut down during the First World War, and the man in charge had stayed with the Air Force). I carried on these studies from April 1 to November 10, 1919, and twenty-eight lysimeters were weighted twice a week to measure the amount of water used, that is, evapotranspiration, by some half a dozen different field crops, also to measuring the daily evaporation from ten evaporation pans varying in diameter from twelve inches to twelve feet and other evaporation pans in use at that time by the U. S. Weather Bureau and the U. S. Bureau of Plant Industry. Also daily measurements were made of temperature, humidity, precipitation and wind

velocity.

In November, 1919, I transferred to Utah to work with the State University and the state engineer on a proposed irrigation project near Ogden. In December, 1919, I returned to Berkeley to assist in preparing a report on Webber Irrigation District, Silt and Water Problems in Imperial Valley.

Then on the first of January, in 1920, I was transferred to Los Angeles to continue the 1917-18 studies on sedimentation in the lower Colorado River and Imperial Valley in the United States and Baja California, Mexico, in cooperation with the Imperial Irrigation District, the University of California, end the state engineer of California, At that time, I was employed by the United States Department of Agriculture, but part of my salary and expenses were paid by the State of California. Many field trips were made to Imperial Valley and the Lower Colorado River. This work was under the supervision of Frank Adams at the University of California, Berkeley and C. E. Tait of the U. S. Department of Agriculture at Los Angeles.

In this report the authors estimated the normal quantity of silt annually transported by the Colorado River to the lower end of the canyon section is 253, 628, 000 tons, or 137, 000 acre-feet, on the basis of an average weight of sediment per cubic foot of eighty-five pounds.

This figure is approximately thirty-seven percent higher than previous estimates have Indicated. Bed sediment in the main canals of Imperial Valley averaged ninety-seven pounds per cubic foot. The amount of sediment that would be deposited in a reservoir at Boulder Canyon at an annual rate of 137,000 acre-feet was estimated to amount to 13,700,000 acre-feet in one hundred years. However, the construction of additional reservoirs, together with a more regulated river flow, and the increased use of water in the Upper Colorado River Basin, will prolong the life of Lake Meade behind Hoover Dam. The results of these were published by the United States Department of Agriculture. *

In 1921, I made a survey of the irrigated area in Southern California, at the request of Frank Adams, in cooperation with the university of California and the State Engineer, which was printed as part of an irrigation map of California in 1922. The 1921 survey included 200,000 acres of irrigated lands in Baja California, Mexico. That was increased in 1961 to about 500,000 acres as compared to about 400,000 acres of irrigated land in

*Silt in the Colorado River and Its Relation to Irrigation, U. S. Department of Agriculture. Technical Bulletin No. 67, by Samuel Fortier and Harry F. Blaney, Washington, D. C., 1928.

Imperial Valley.

The people of Imperial Valley were very happy about the building of Hoover Dam because it would control, eventually, the silt deposits in their canal which cost about one million dollars a year to clean. Of course, the other reasons were that it would control floods and provide water at all seasons of the year and make possible the building of the All-American Canal to serve Imperial Valley and Coachella Valley.

With reference to the amount of water that was being used in 1922, the average amount of water, or depth of water applied per acre, was four ace-feet in Baja California, and applying this to 200,000 acres of irrigated land at that time would give Mexico the right to some 800,000 acre-feet of water a year from the Colorado River. In the United States treaty of 1944 with Mexico, under the good neighbor policy, they were granted 1,500,000 acre-feet of water from the Colorado River and 200,000 acre-feet additional water, if available. They have used a maximum of 1,700,000 acre-feet and irrigated up to 550,000 acres of land in Mexico. This treaty with Mexico was fought by California and Nevada and some interests in Arizona. However, on the basis of Mexico controlling the waters in the lower Rio Grande and agreeing to give additional water to the lower Rio Grande Valley in the United States, it was considered by some

that the Mexicans were trading Rio Grande water for Colorado River water, which was really the case.

Cost of Irrigation Water

In 1922, I made a survey of the entire state on cost of irrigation water in cooperation with the U. S. Department of Agriculture and the University of California. It was headed by Prank Adams of the Irrigation Division and State engineer of California, and was a study of cost water and duty of water per acre of irrigation enterprises in California, which included public utilities, mutual water companies, irrigation districts and private pumping plants. This was published as California State Bulletin No. 8, Cost of Water to Irrigators in California, 1925, by Harry F. Blaney.

In 1930, an additional study in cooperation with the U. S. Department of Agriculture, the University of California and the state engineer was undertaken by Harry F. Blaney and Professor Martin R. Huberty of the University of California to determine the irrigation use of water and cost of water by some six hundred irrigation enterprises throughout the state. This was published in 1930 as Cost of Irrigation Water in California, by Harry F. Blaney and Martin R. Huberty, by the State Division of Water Resources as Bulletin No. 36. This investigation was based on the cost of water and water use in 1930.

Irrigation Requirements in San Diego County

In 1925, at the request of the state engineer of California and Frank Adams, a cooperative study was undertaken with the University of California and the U. S. Department of Agriculture under the leadership of Professor S. H. Beckett, Harry F. Blaney and Colin A. Taylor on transpiration use and irrigation requirements in San Diego County. The request for this information was to settle a controversy between those organising irrigation districts in San Diego County allowing only a little over twelve acre-inches per acre of water for irrigation, as the state engineer did not want to approve the formation of these districts which were under his supervision without some research data to determine what the actual use might be. The study developed that for the irrigation of citrus and avocado fruits in San Diego County, when the trees were mature there should be from fifteen to eighteen acre-inches of irrigation water in addition to the average rainfall of twelve inches. A few irrigation districts were formed, on this basis and approved by the state engineer. The results of these studies were published as Bulletin 489, the university of California, entitled Irrigation Water Requirement Studies of Citrus and Avocado Trees in San Diego County, California, 1926-1927.

Cooperative Studies in Southern California

In 1926, I was put in charge of most of irrigation and use of water research studies in Southern California, in cooperation with the State of California and other agencies for the U. S. Department of Agriculture Under the direction of W. W. McLaughlin, Chief of Irrigation Division of the United States Department of Agriculture at Berkeley, California.

Use of Water in San Fernando Valley

At the request of Los Angeles City Department of Water and Power, in 1926 I started a study of evaporation and transpiration use of alfalfa, oranges, walnuts and vegetables in San Fernando Valley. A report was prepared on the Use of Water by Irrigated Crops in San Fernando Valley, Los Angeles, California, 1927-29. During this period, some 50,000 to 70,000 acres were irrigated in the Valley with water furnished from the Owens River Aqueduct.

Rainfall Penetration and Consumptive Use of Water

In 1927, at the request of the State Engineer of California, I was put in charge of study of consumptive use of water by natural vegetation and irrigated crops and rainfall penetration to groundwater in the Santa Ana River Basin, in San Bernardino, Riverside and Orange Counties,

Ninety rainfall stations were established for this purpose throughout the valley areas, and soil samples were taken in different types of vegetative cover to depths of ten to eighteen feet. Evaporation and transpiration stations were installed at San Bernardino and Santa Ana to determine evaporation-transpiration losses from moist areas with tanks. After two years of study, 1928-29, a report entitled Rainfall Penetration and Consumptive Use of Water in the Santa Ana River Valley and Coastal Plains by Harry F. Blaney and others was published by the State Division of Water Resources, Bulletin No. 33, in 1930.

In 1930-32, this study expanded to include loss of water by riparian vegetation along stream channels and consumptive use of water by salt grass, tules, and willows in areas with a high water table in the Santa Ana and Mojave River Basins. This report, entitled the South Coastal Basin Investigations, Water Losses Under Natural Conditions from Wet Areas in Southern California. by Harry F. Blaney and others, was published by the State of California as Bulletin No. 44, 1933.

Farm Loan Problems in imperial and Coachella Valleys

In the 1933 depression, a cooperative study was requested by the Farm Credit Administration of the United States Department of Agriculture and the Federal Land Bank

of California to make a survey of the drainage, water supply, economic and flood problems of Imperial Valley and Coachella Valley with the view of the Federal Land Bank granting fifteen-year loans on farm lands. These loans had been withdrawn several years before that, and since the banks of Imperial Valley and Coachella Valley were closed in 1933 and the farmers needed loans to continue during the depression period, Paul A. Ewing, and Harry F. Blaney of the U. S. Department of Agriculture, Walter W. Weir of the Soil Division of the University of California, and John H. McCormick, representing the Federal Land Bank were chosen for this survey. The report cost some $15,000 and covered a thirty-day study in Imperial Valley and a two-week investigation in Coachella Valley. A field trip was made over route of the All-American Canal and to inspect flood conditions along the Colorado River in United States and Mexico. The air temperatures ranged up to 120 degrees F. The Imperial Irrigation District staff took us to the Hoover Dam Site and along route of the Colorado River Aqueduct. Two weeks were spent on a study of water supply, drainage, flood and economic conditions in Coachella Valley. After a thorough study, the authors recommended that the Federal Land Bank enter these valleys again with fifteen-year loans. This helped the farmers to proceed during these depression years and eventually to continue operation and pay off their indebtedness to a

great extent. This was a confidential report and full cooperation was received from the Imperial Irrigation District on the economic studies, studies of drainage and irrigation requirements, water supply and flood control problems. *

Water Supply Shortages, San Joaquin Valley

During the 1934 drought, at the request of the State Engineer Hyatt of California, I along with four other irrigation engineers made a survey of the limited water supply in the San Joaquin Valley. A report was made, The 1934 Water Shortage in San Joaquin Valley, California by P, A. Ewing, P. C. S. Cobey, H. F. Blaney, O. V. P. Stout and A. A. Young, U. S. Department of Agriculture, 1934. As the result of this study, the Central Valley Project was initiated by the State and Federal governments.

Water Conservation in New Mexico, 1934-35

In 1934 and '35 during the drought in New Mexico, Texas, Colorado, Arizona and California, the Federal National Emergency Relief Administration requested the

*Investigations in Imperial and Coachella Valleys, California, by Harry F. Blaney, F. C. S. Cobey, Paul A. Swing, J. H. McCormlck, Walter W. Weir, USDA Bureau of Agriculture, Vol. I, II, 360 pp. 1934. Mimeographed.

U. S. Department of Agriculture to loan men as water conservation engineers in these states to help relieve the water supply shortage. Harry F. Blaney was assigned as Water Conservation Engineer in New Mexico to supervise the design of dams, rehabilitation of irrigation systems, and to develop the water supplies for relief off drough areas in that state where thousands of cattle were starving as a result of no pasture and dust storms and no water supply. Many herds were killed by rifle firing squads.

This development project was conducted in cooperation with the state engineer of New Mexico, the U. S. Department of Agriculture and the New Mexico Emergency Relief Administration under the supervision of Margaret Reeves, administrator--one of the few women administrators in the United States. She assigned me to an office in the State Capitol Building at Santa Fe in a large room with twenty-five women social service workers and two engineers. I refused to work in such an office because I had to have room for a secretary and two engineers. I visited the office of the State Engineer of New Mexico across the hall and he gave me space for my staff which I accepted against the advice of my woman supervisor, whom I learned later did like the State Engineer, because Harry Hopkins, Chief Engineer from Washington, D. C. spent only fifteen minutes with her and two days with the State Engineer inspecting the water conservation program in New Mexico. She wrote

the Washington office to keep their engineers out of New Mexico. Apparently when I reported for duty a month later as her advisor, she concluded I was a spy and cut my salary. Then I wired toy chief in Washington, D. C. to pay my salary from government funds.

The State Engineer, Thomas McClure, was very cooperative and spent some time driving me over many water shortage problems throughout the State. I had authority to approve up to $50,000 for material to rehabilitate water projects and construct or repair dams to conserve water. One of the biggest Jobs I had was to stop the leakage from the sides of Lake McMillan and the water being lost near the spillway. Most water was being lost rather than being diverted for irrigation of the U. S. Bureau of Reclamation Carlsbad Project. Several miles of levees were built along the east side of the reservoir, and bales of hay were dumped to a large hole in the bottom of the reservoir to stop the leakage.

This was a very interesting assignment. I stayed in La Fonda Hotel when in Santa Fe and my wife spent more than a month with me. I introduced her to my supervisor, the twenty-five women social service workers and others in the capital, and she stayed with me for the annual fiesta, celebrating the founding of Santa Fe in 1590 by the King of Spain. It is the second oldest city in the United States and in 1934 had a population of about 14,000 with

90 percent Indians or Spanish-Americans. The State legislature was conducted in English and Spanish.

Several towns were very short of water. For example, the town of Lumberton had to haul water for five miles in barrels at the cost of one dollar per barrel, and each family was limited to one barrel per week. I designed a pipe to carry the water to the town. I designed several dams to store water in reservoirs for other towns. One was a log dam.

Since I had to approve all water projects, I had a chance to meet important people, such as the governor and state senators who wanted projects in their counties. The most charming senator was Louise Coe of Lincoln County, whose husband had written a book on Billy the Kid. About March, 1935 the governor requested the administrator to resign because she would not cooperate with Federal Officials, and an engineer was appointed to the position. After one year on this assignment I returned to Los Angeles.

Mojave River Study

In 1935, the cities of San Bernardino, Riverside and Santa Ana and ten water companies requested the United States Secretary of Agriculture to authorise a survey of the water supply of the Mohave River Basin, with the view of transporting any surplus of water in this basin to the Santa Ana River Basin. Secretary of Agriculture Henry A.

Wallace ordered Harry F. Blaney and Paul A. Ewing to make such a survey. The study was completed in August, 1935 and the report, Utilization of the Waters of the Mojave River, California by Blaney and Ewing, suggested that 15,000 to 20,000 acre-feet of water which was not being used in the Mojave River Basin could be diverted for use in the Santa Ana River Basin. Owners of land in the Mojave Valley protested, so the diversion was never made.

Upper Rio Grande Basin Investigation

Prom April 1936 to March 1937, I was in charge of consumptive use of Water investigation of 700 miles of the Upper Rio Grande in Colorado, New Mexico and Texas with headquarters in Albuquerque, New Mexico. This study was requested by the National Resources Committee. It was conducted by the Bureau of Agricultural Engineering, United States Department of Agriculture, in cooperation with the state engineers of Colorado, New Mexico and Texas, as part of a complete inventory of the water supply and land use in the Upper Rio Grande Basin above Port Quitman, Texas (See Figure 2). Stations were established at Alamosa, Colorado, at Albuquerque, and State College in New Mexico, for measuring consumptive use of water by irrigated crops and native vegetation and evaporation from water and land surfaces. Unit rates of consumptive use in acre-feet per acre were estimated from the measurements and applied to acreage obtained from aerial photo-

graphs for estimating volume consumptive use in acre-feet for different sections of the valley areas. The results were published as "Consumptive Use of Water Studies" by Harry F. Blaney, Paul A. Ewing, 0. W. Isrealsen and others in Part III, Water Utilization in the Upper Rio Grande Basin, National Resources Committee. Washington, D. C., February, 1938.

Pecos River Joint Investigation

In 1939, the Bureau of Agricultural Engineering was abolished and I was transferred to the Division of Irrigation, Soil Conservation Service, United States Department of Agriculture. At the request of the National Resources Planning Board, I was put in charge of the Consumptive water use and requirements studies along six hundred miles of the Pecos River from northern New Mexico to where it Joins the Rio Grande in Texas (See Figure 3).

The principal duty of the assignment was the ascertainment of the consumptive use of water by agricultural crops and native vegetation, losses by evaporation from water surfaces and bare land. A key evapotranspiration with tanks was established at Carlsbad, New Mexico to determine the consumptive use for salt grass, sacaton, tules and salt cedars and evaporation from bare soil and free-water surface. Class A U. S. Weather Bureau evaporation

stations were to measure pan evaporation, temperature, humidity, and wind velocity at Las Vegas, Alamogordo, Roswell, Lake McMillan, Carlsbad, in New Mexico and Red Bluff, Grandfalls, Balmorhea, and Fort Stockton in Texas. These data were correlated with measured use of water by native vegetation and irrigated crops to estimate consumptive use throughout the entire Pecos River Basin. The following tabulations summarises the average unit consumptive water requirements in acre-feet per acre and total consumptive water requirement in acre-feet, in the Upper, middle and Lower Pecos River areas. The results were published as "Consumptive Water Use and Requirements," by Harry F. Blaney, Paul A. Ewing, K. V. Morin and Wayne D. Criddle, in Section 3, Part III, Report of Participating Agencies, Pecos River Joint Investigation, National Resources Planning Board, Washington, D. C., 1942.

From the results of the Pecos River studies, empirical formulae were developed for computing evaporation and consumptive use of water from monthly temperature, humidity, and percentage of daytime hours of the year. The factors involved are shown in the equation, u=ktp (114-h) =kc, in which u=monthly consumptive use (or evaporation) in inches; k=monthly empirical coefficients; t=mean monthly temperature, degrees F; p=monthly percentage of daytime hours of the year; h=average monthly humidity; and

c=tp(l14-h)=monthly use Index (climatic factor). The formula for annual consumptive use (or evaporation) in inches is, U=KC. A detailed description is given in the publication entitled "Evaporation and Consumptive Use of Water Formulas, " by Harry F. Blaney, and Karl V. Morln, Part I, Transactions of American Geophysical Union, June, 1942.

Agricultural Survey in Cuba

From January to April, 1941, I was the irrigation engineer member of a four-man Technical Commission of the United States Department of State to review the request of Cuba for a fifty-million-dollar loan from the United States to rehabilitate their agriculture program of production of rice, sugar cane, tobacco, and other crops. A study was made of water supply, irrigation requirements, ground water, rainfall and soils. The commission included experts on sugar, tobacco, soils, land settlement, Hydrology and irrigation. As the result of World War II which had started in Europe and Asia, ninety percent of Cuba's rice supply had been cut off and there was no market for sugar. We worked with the former professor at the University of Havana, and Secretary of Agriculture, and spent two months inspecting eight hundred miles of the island. After examining twelve dam sites on horseback, I recommended building several dams to supply water for

irrigation of rice, as the Cuban yield per acre was only one-fourth of that of California, because of one or two drought periods in Cuba during the rainy season, and even with a precipitation of over thirty to forty inches this crop needed continued irrigation for a seven-month growing season for maximum production. The Cuban national food was rice and chicken.

We were well treated by the Cubans, given passes to country and night clubs, and entertained by the United States Ambassador. Every weekend during February the Cubans paraded with a fiesta on the main street, and we were invited to attend masked American and Cuban dances.

In March, 1941, our commission returned to Washington, D. C. for several weeks to prepare our report and recommendations. I was invited to return to Cuba to organize a hydrology division in the Ministry of Agriculture and to make plans for building small dams for diverting water for irrigation late in 1941. However, this was prevented by the entrance of the United States in World War II. The commission prepared a Report on Agricultural Survey of Cuba by Q. Laguardia, Wilson Popenoe, Harry F. Blaney, Paul Minneman and W. Shaddick, U.S. Department of State, 1941, 245 pp.

Water Utilization in Riverside County

In 1938, Mr. P. E. Weymouth, General Manager and

Chief Engineer, Metropolitan Water District of Southern California, requested the Secretary of Agriculture to authorize the United States Department of Agriculture, Division of Irrigation to make a study of water utilization and an irrigation study of the Beaumont and San Jacinto basins in Riverside County, California, similar to the study made on the Upper Rio Grande in 1936-37. I was assigned along with Arthur A. Young and Paul A. Ewing to make this investigation on agriculture, water supply, use of irrigation water on farms, water consuming areas and consumptive use of water. A report was prepared, Utilization of the Waters of Beaumont Plains and San Jacinto Basin, California by Arthur A. Young, Paul A. Ewing and Harry F. Blaney, United States Soil Conservation, 1941, 333 pp. (See Figure 4).

San Luis Rey River Study, San Diego County

In January, 1939, Edward Hyatt, State Engineer, and Harold Conkling, Deputy State Engineer of California Division of Water Resources, requested W. W. McLaughlin, Chief, Division of Irrigation, Soil Conservation Service, United States Department of Agriculture, to make a study of water utilisation on the lower San Luis Rey valley, The field work was made by Dean C. Muckel under my immediate supervision. The investigation was a survey of water supply, and water consuming areas, measurements

of consumptive use of water by native grass, cottonwoods, and tules. Evaporation, evapotranspiration, rainfall stations were established along with wells to measure depths to water tables in the sub basins. A Class A evaporation station was installed in the Bonsall Basin to measure evaporation, temperature, humidity and wind velocity. Consumptive use by cottonwoods and tules were measured from tanks, six feet in diameter and six feet deep. The water table in cottonwood tank was maintained at two feet for two years and four feet for three years. Figure 5 shows the annual consumptive use by native vegetation while growing with a water table ranging from three to twelve feet below the ground surface.

From aerial photographs, the areas of irrigated land, dry farming, native vegetation and miscellaneous areas were determined. Unit rates of consumptive use for various areas were estimated and applied to acreage to compute total use of water in the valley in acre-feet, The total consumptive use by 6,390 acres of native vegetation was estimated as 17,315 acre-feet per year. If the water table was lowered twelve feet by pumping to reduce the water lost by noneconomlc vegetation, it was estimated the amount of water available for salvage would be 9,280 acre-feet annually. On the basis of this, the State Water-rights Division allowed the Fallbrook Public Utility District to pump water from the ground-water basin several

hundred feet to irrigate its citrus and avocado orchards. A report on these studies was published, The Utilization of the Waters of Lower San Luis Rey Valley, San Diego County, California, by Dean C. Muckel and Harry F. Blaney, United States Soil Conservation Service, 1945, 145 pp.

Summary of Water Use by Native Vegetation

At the request of State Engineer Edward Hyatt, Arthur A. Young and I reviewed the literature on consumptive use by native vegetation in Western United States and prepared a report, which was published as Use of Water by Native Vegetation, by Arthur A. Young and Harry F. Blaney, Bulletin No. 50, Division of Water Resources, State of California, 1942, 160 pp.

Emergency Rubber Project of United States Forest Service, World War II, 1942-43

In January, 1942, I was appointed Head of the Irrigation Section of the Emergency Rubber Project of the U. S. Forest Service, to increase the yield of rubber from the guayule by irrigation. Ten members of the staff of the Irrigation Division, U. S. Soil Conservation Service were loaned to the Forest Service to work under my supervision to determine the adequacy of the water supply and irrigation systems to be leased for growing guayule. Because of World War II, the supply

of natural rubber had been cut off from United States. Information was obtained on the quantity, quality and cost of irrigation water on farms selected by the soil survey for leasing. Also survey was made to determine whether the land could be irrigated by furrows, the satisfactory system for irrigating guayule. About fifty reports were made from the results of these surveys; thirty-four in California, ten in Arizona and six in New Mexico-Texas. * Some 50,000 acres of land were leased at $25.00 per acre and planted to guayule from nursery stock.

Late in 1943, the project was closed because farmers in Santa Barbara County would lease their land at $25.00 per acre as they preferred to grow food crops. About that time, producing good synthetic rubber tires for Army trucks on a large scale was successful. The Federal rubber control office ruled that producing food was more important than growing guayule for rubber.

Survey of U.S. Bureau of Reclamation Projects

During World War II, I was loaned to the War Production Board in 1943 to determine whether food could be

*Report on Activities of the Irrigation Staff, Emergency Rubber Project, by Harry F. Blaney and Staff, U.S. Forest Service, 1943, 243 pp.

produced within two years on the U. S. Bureau of Reclamation irrigation projects in the Central Valley and Coachella Valley of California. The construction work on these projects had been closed on account of the shortage of steel. The Friant Dam and reservoir could not be operated to divert water to the Madera and Kern County canals for irrigation. After visiting the project I recommended steel be furnished to complete the gates on the dam.

An inspection was made of the Coachella Valley project and I found that the contractor for the lining of the Coachella Branch of the All-American Canal had stopped because he had underestimated the cost by $250,000 and he claimed a shortage of labor because of the War. I concluded, since all the steel and cement for completing the canal was at the site, the contractor should be ordered to complete the project. Then I was sent to Washington, D. C. to testify before the Federal War Production Board hearing on the problem at the request of Congressman Philip D. Swing and a Senator from California. The contractor and the Bureau of Reclamation engineers attended the meeting. It was decided that since the contractor was one of the six contractors who made so much money in building the Hoover Dam, he should complete the work on lining the Coachella Canal. This work was completed in 1944 (See Figure 5).

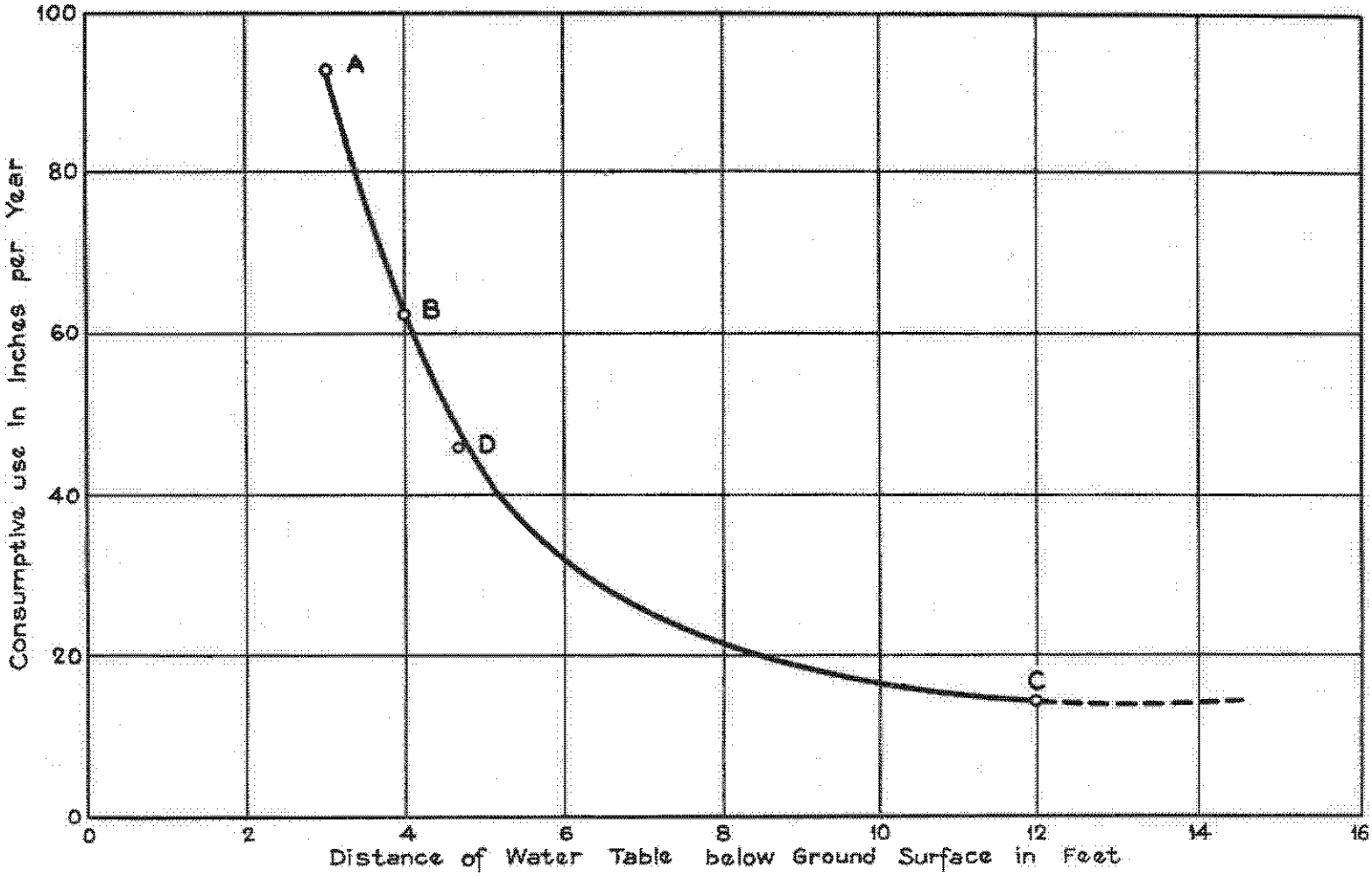

FIGURE 5.

CONSUMPTIVE USE BY NATIVE VEGETATION
SAN LUIS REY VALLEY, CALIFORNIA

Drainage Investigations, Imperial Valley, 1941-52

From 1941-1952, I was project Supervisor of drainage and ground water investigations in Imperial Valley. The project also included studies of evaporation from Salton Sea (See Figure 6).

The objective of the studies of the drainage problem was to establish the feasibility of tile drainage of lands within the Imperial Irrigation District to supplement the surface drainage canals which had been constructed in the twenties. Prior to 1941, tile drainage had not been too successful for soils in some areas. Only 20,000 acres of irrigated land had been tiled. W. W. Donnan, V. S. Aronovici and William Fox were in charge of field work for the Soil Conservation Service, which was in cooperation with the Imperial Irrigation District. In addition to drainage investigations, measurements were made at three Class A evaporations around Salton Sea, and also survey was made of depth to water table in wells in Imperial County. As the results of the ten-year study, by 1952 tiles had been installed in over 200,000 acres of land.*

*Drainage Investigation in Imperial County, California. 1941-51, by William W. Donnan, George Bradshaw and Harry F. Blaney, SCS-TP-120, U.S. Soil Conservation Service, 1954, 71 pp., illus.

Blaney-Criddle (B-C) Consumptive Use Formula

From 1945 to 1961, in collaboration with Wayne D. Criddle, while with the United States Soil Conservation Service and the Agricultural Research Service, we revised the method developed in the Pecos River Investigation for determining water requirements in irrigated areas from climatological and irrigation data. Preliminary reports were made under this title in 1945 and 1950. In 1961, the B-C method was perfected and printed, entitled Determining Consumptive Use and Irrigation Water Requirements by Harry F. Blaney and Wayne D. Criddle, Technical Bulletin No. 1275, Agricultural Research Service, U. S. Department of Agriculture, Washington, D. C., December 1962, 59 pp.

A summary of this bulletin follows:

> This report includes results of experimental studies in the United States and several foreign countries. An empirical formula is developed from these results, showing the relationship between temperature, length of growing season, monthly percentage of annual daytime hours, and consumptive use of water by crops and natural vegetation and an irrigation requirement can readily be estimated for any area where the basic climatological data are available.
>
> The procedure was developed by correlating measured consumptive-use data with monthly temperature, monthly percentages of yearly daytime hours, precipitation, and growing or irrigation season. The coefficients thus developed allow for the computation of consumptive use of each crop if the monthly temperature, latitude, and growing period of the crop are known and if the computed monthly percentage of annual daytime hours are available.

Estimated seasonal consumptive use in inches can be computed from the formula

$$U=KF$$

where U=use of water in inches;
K=empirical seasonal coefficient;
F=sum of the monthly factors (f) for the season (sum of the products of mean monthly temperature (t) in degrees Fahrenheit and monthly percentage of annual daytime hours (p)).

The equation for monthly or short-period consumptive use in inches is $u=kf$, where $k=txp/100$.

The net amount of irrigation water necessary to satisfy consumptive use is found by subtracting the effective precipitation from the consumptive-use requirement for the irrigation season. This net requirement of irrigation water, divided by the irrigation efficiency, indicates the seasonal irrigation requirement of the crop.

This report covers not only studies in the United States, but the results of work in many foreign countries. The method has been employed by the United States Bureau of Reclamation, the Soil Conservation Service and the Agricultural Research and many western states to determine consumptive water requirements, stream depletion, and evaporation in irrigated areas in river basins. The method has been used in over ten reports of the State of California; for example, Bulletin No. 2, Water Utilisation and Requirements for California, Volumes I and II, 1955, and in the Upper and Lower Colorado River Basins.

California State Bulletins Using B-C Method

Many investigations on water resources by the State of California have used the Blaney-Criddle method to determine consumptive use and irrigation requirements A partial list of published bulletins are as follows: Santa Cruz-Monterey Counties Investigations, Bulletin No. 5, California State Water Board, August 1953, p. 51.

Klamath River Basin Investigation, Bulletin No. 83, California Division of Water Resources Planning, May 1960, p. 55.

San Joaquin County Investigation, Bulletin No. 11, California Water Resources Board, June 1955, p. 61-63.

Water Utilization and Requirements of California, Bulletin No. 2, California State Water Resources Board, Vol. 1, June 1955, p. 50.

Santa Clara Valley Investigation. Bulletin No. 7, California State Water Resources Board, June 1955, p. 55.

Northeastern Counties Investigation, Bulletin No. 58. California Department of Water Resources, December 1957, pp. 149-150.

Shasta Valley Investigation. Bulletin No. 87, California Department of Water Resources, July 1964, p. 80.

Lake County Investigation, Bulletin No. 14, California Department of Water Resources, July 1957, p. 38.

Santa Margarita River Investigation, Bulletin No. 57, Vol. I, California Division of Water Resources, June 1956, pp. 154-155.

Orange County Land and Water Use, 1957, Bulletin No. 70, California Department of Water Resources, January 1959, p. 42.

Salinas Basin Investigations, Bulletin No. 52, California Division of Water Resources, 1946, p. 212.

Studies for Operation Division, U. S. Soil Conservation Service

In 1945 I spent several weeks in Western Texas and Oklahoma studying irrigation practices and consumptive use by crops. Reports were prepared for Plainview, Texas and Altus, Oklahoma for the U. S. Soil Conservation Service at Fort Worth, Texas. The studies included estimates of irrigation requirements for alfalfa, cotton and grain by the B-C Method.

In 1953, I spent six weeks in the Atlantic coast states, from Florida to Vermont, determining the water requirements, under sprinkler irrigation, for tobacco, peaches, cotton, pasture and other crops by the B-C Method. Some $25,000,000 worth of crops had been lost

during the previous year on account of drought conditions. Reports were made to the Soil Conservation Service in Washington, D. C., and the regional offices for the southwest and northwest Atlantic coast states. Consumptive water requirements were estimated toy B-C Method.

Consumptive Use in the Upper Colorado River Basin

In January 1948, at the request of the Upper Colorado River Basin Compact Commission, representing the states of Arizona, Colorado, New Mexico, Utah and Wyoming, through George D. Clyde, Chief of Division of Irrigation and water Conservation, U. S. Soil Conservation Service, I made a tentative office report on the consumptive use by irrigated crops and native vegetation in the subbasins and for each state. In March 1948, I was joined by Wayne Criddle and two representatives from each state and the U. S. Bureau of Reclamation to make field survey of fifty-three areas, two in Arizona, twenty-eight in Colorado, three in New Mexico, sixteen in Utah and Seven in Wyoming (See Figure 7). This was under the general direction of George D. Clyde, Chief of the Irrigation and Water Conservation Division of the U. S. Soil Conservation Survey (he later became Governor of Utah). The results

of this study of consumptive water requirements of irrigated crops, native vegetation and water evaporation were used to draw up a compact between the States of Arizona, Colorado, New Mexico, Utah and Wyoming, which was approved in 1949 by the state legislatures and Congress, and the waters apportioned to these states was on the basis of the amount of water use determined for each of the states involved. The title of this report was Consumptive Use of Water in the Irrigated Areas of the Upper Colorado River Basin, by Blaney and Criddle, U. S. Soil Conservation Service, 1949, 49 pp., illus.

Consumptive Use in Lower Colorado River Basin

At the request of the Bureau of Reclamation of the U. S. Department of the Interior, 1950, the writer and Karl Harris of the U. S. Soil Conservation Service made a study and a report entitled Consumptive Use of Water Rates in the Lower Colorado River Basin, 1952, 89 pp., illus. This was based on the measured consumptive use data in Arizona and the B-C Formula. The results included consumptive use by irrigated crops and native vegetation in Arizona, California, Nevada, New Mexico and Utah, within the Lower Basin. Some forty-two areas were inspected in the field in cooperation with Bureau of Reclamation staff. This Soil Conservation Report

was published as Appendix B of the Report on Water Supply of the Lower Colorado River Basin, 1952, U. S. Bureau of Reclamation (see Figure 7).

Settling Use of Water Disputes

At the request of the Dean of the university of New Mexico School of Law, I initiated a report on the Blaney-Criddle method of determining consumptive use that attorneys could use in negotiations, adjudications and litigations of water rights. After reviewing the literature on the subject, a report was prepared giving examples of the use of the B-C method in the Upper and Lower Colorado River, Upper Rio Grande, Pecos River basins, and between states and nations in water use controversies! "Determining Water Requirements For Settling Water Disputes," by Blaney and Criddle, Vol, 4, No, 1, Natural Resources Journal, May 1964, pp, 29-41,

Consumptive Use and Irrigation Requirements, Arizona, Colorado and New Mexico

The B-C method was used to determine consumptive water requirements in the following reports by the U. S. Soil Conservation Service after field and office studies of available data:

Consumptive Use and Irrigation Requirements of Crops in Arizona, by Blaney and Harris, 1951, 49 pp.

Consumptive Use and Irrigation Requirements of Crops in Colorado, by Blaney and Criddle, 1949, 55 pp.

Consumptive Use and Irrigation Requirements of Crops in New Mexico, by Blaney and Litz Hanson, (in cooperation with Hew Mexico State university), 1950, 34 pp.

At the request J. R. Riter, Chairman of U. S. Department of Interior Technical Committee and representatives of the Navajo Tribal Council and Interstate Stream Engineer of New Mexico, an estimate was made of probable irrigation water required at the headgates based on consumptive use, irrigation efficiency, crops and soils by the B-C Method. This study was to determine and recommend the diversion requirements of water from the San Jinan River for both the proposed Shiprock and South San Juan irrigation projects. After a field study by Harry F. Blaney, Principal Irrigation Engineer and C. H. Diebold, Soil Scientist of the U. S. Soil Conservation Service, a sixty-page report was made entitled, Irrigation Water Requirements of Crops in Shiprock and South San Juan Projects. New Mexico, October 1952. These projects have been completed.

Irrigation Practices and Consumptive Use in Valleys of California

Field investigations were made at Salinas, Pajaro, and Lake County valleys by the U. S. Soil Conservation

Service in cooperation with the California State Division of Water Resources on irrigation practices and water requirements for agriculture crops and native vegetation.

Consumptive use was estimated by the B-C method The results are presented in the following reports by Harry F. Blaney and Paul A. Ewing.

"Irrigation Practices and Consumptive Use of Water in Salinas Valley, California," California State Department of Public Works, Division of Water Resources, Bulletin 52, 1946, Appendix C, pp. 195-226.

Irrigation Practices and consumptive use of water in Pajaro Valley. California. USDA Soil Conservation Service, December 1949, 62 pp.

"Irrigation Practices and consumptive use of water in Lake County, California." Lake County Investigation State Water Resources Board, State of California, Appendix J. Bulletin No. 14, September 1955. (Also mimeo. report same title June, 1953, 60 pp. illus.)

At the request of the State Engineer of California in August, 1952, as State Research Supervisor for the U. S. Soil Conservation Service, I initiated a cooperative study to determine the consumptive use of water by irrigated crops and native vegeta-

tion, and to obtain information on farm Irrigation use in the upper Santa Margarita Basin in Riverside and San Diego Counties. The results of the investigation were published in "Consumptive Use of Water in the Santa Margarita River Basin, California," by Harry F. Blaney and G. L. Corey, California Division of Water Resources, Bulletin No. 57, Vol. II, Appendix, June 1956, pp. 55. Also, "Irrigation and Consumptive Use of Water in the Santa Margarita River Basin, Riverside and San Diego Counties, California," was prepared by William W. Donnan, G. Marvin Litx and Harry F. Blaney, U. S. Soil Conservation Service, April 1954, pp. 57.

Investigations in Soil Conservation Districts

From 1946-54, I was State Research Supervisor and Principal Irrigation Engineer in the Division of Irrigation and Water Conservation in the U. S. Soil Conservation Service under the direction of George D. Clyde, Chief of the Division.

July 1, 1950, at the request of the Board of Directors of the Tehachapi Soil Conservation District, investigations to determine the available water supply for irrigation were initiated under my direction. The study included an inventory of the water supply and potential net safe yield of the

underdeveloped surface and underground water for the agricultural use within the district. A report was prepared entitled, Irrigation and Water Supply Investigations in the Tehachapi Soil Conservation District, Kern County, California, by William W. Donnan and 0. Marvin Litz (under supervision of Harry F. Blaney), June 1953, 68 pp., illus.

A somewhat similar study on available water supply for irrigation and domestic use was made in 1951. A report was prepared entitled, Irrigation and Water Supply Investigations, Upper Santa Clara Soil Conservation District, Los Angeles County, California, by Gilbert L. Corey, G. Marvin William W. Donnan and Harry F. Blaney, U.S. Soil Conservation Service, May 1955, 33 pp. illus.

Ventura County Flood Control District, California

ment between Ventura County Flood Control District, the State of California and the U.S. Soil Conservation Service, the basic factors underlying the replenishment of the ground water supply by return waters from irrigation of crops, rainfall and water spreading, were to be determined in Zone 3 of the District. The results were published in the report, Ground Water Replenishment by Penetration of Rain-

fall, Irrigation and Water Spreading, by Dean C. Muckel, William W. Donnan, V. S. Aronovici, and G. Marvin Litz (under supervision of Harry F. Blaney, State Research Project Supervisor), April 1953, 63 pp. illus.

Evaporation and Consumptive Use in the San Francisco Bay

In 1953, the California State Engineer, A. D. Edmonston, requested Harry F. Blaney, State Research Project Supervisor, U. S. Soil Conservation Service, to make a cooperative study to determine rates of evaporation and consumptive use of water by marsh vegetation (tules, cattails and saltgrass) in the San Francisco Bay areas involving the whole subject of the feasibility of proposed barriers across the San Francisco Bay to create fresh water pools to conserve water flowing into the Bay from the Sacramento and San Joaquin rivers for irrigation, domestic, and industrial purposes.

Evaporation and consumptive use of water stations were installed and estimates made of lake evaporation and consumptive use by marsh vegetation, by Blaney-Criddle method with Dean C. Muckel in charge of field work. The following reports were made by Harry F. Blaney and Dean C. Muckel.

"Evaporation and evapotranspiration investigations in the San Francisco Bay area," American Geophysical Union Transactions, 36: 5, October 1955, pp. 813-820.

Rates of Evaporation and Consumptive Use in the San Francisco Bay and Adjacent Areas, California, U. S. Department of Agriculture, Agriculture Research Service, 1955, 82 pp.

Consumptive Water Requirements

Other of ray published reports on consumptive use of water are as follows:

"Consumptive Use--Definitions, Methods and Research Data," by Harry F. Blaney, Paper No. 2524, Trans., Vol. 117, ASCE, 1952, pp. 948-973, illus.

"Monthly Consumptive Use Requirements for Irrigated Crops," by Harry F. Blaney, Irrigation and Drainage Journal, Paper No. 1963, ASCE, March 1961, 12 pp. illus.

"Monthly Consumptive Use by Irrigation Crops in Western United States," by Harry F. Blaney, Agriculture Research Service, U. S. Department of Agriculture, 1959, 53 pp.

"Consumptive-Use Requirements for Water in Drainage Basins," by Harry F. Blaney. Agricultural Engineering, Vol, 35, No. 12, December 1954, pp. 870-875, illus.

"Irrigation Requirements of Crops," by Harry F. Blaney, Agricultural Engineering, Vol, 32, No. 12, December 1951, pp. 665-658, illus.

"Determining Evapotranspiration by Phreatophytes from Climatologlcal Data," by Harry F. Blaney, Transactions, American Geophysical Union, Vol. 38, No. 1, 1952, pp. 61-65, illus.

"Consumptive Use and Water Waste by Phreatophytes," by Harry F. Blaney, Paper No. 2929, Irrigation and Drainage Journal, ASCE, September 1961, pp. 37-46.

Evaporation Studies in California

I was Research Project Supervisor or co-author of the following reports on evaporation studies from water surfaces in California, conducted by the U. S. Department of Agriculture in cooperation with the State Division of Water Resources:

Evaporation from Water Surfaces in California Summary, Bulletin No. 54, by Arthur H. Young, State of California, 1948, 200 pp.

Evaporation from Water Surfaces in California, Bulletin No. 54-B, by Harry F. Blaney and Gilbert L. Corey, October 1955, 98 pp.

Evaporation from Water Surfaces in California. Bulletin No. 73, by Harry F. Blaney and Dean C. Muckel, October 1959, 61 pp., illus.

Evaporation Studies at Lake Elsinore, California by Arthur A. Young, U. S. Soil Conservation Service, 1942, 56 pp.

Comparison of Evaporation of Several Types of Evaporation Pans, Baldwin Park, California, by Arthur A. Young and Harry F. Blaney, U. S. Soil Conservation, 1942, 226 pp.

Evaporation from Silver Lake, Mojave Desert

In March, 1938, following a storm in the San Bernardino mountains, flood waters of the Mojave River filled Silver Lake, usually a dry plays, to a depth of seven feet with water surfaces areas seven miles in length by three-miles in width. Early in May 1938, Blaney and Young of the U. S. Soil Conservation Service established on the beach at the north of the lake a Class A evaporation station with a Weather Bureau pan in the lake for measuring changes

in water surface elevations. The station was operated for one year. The results show that annual evaporation from Silver Lake was about 79 inches and that a coefficient 0.60 could be used in reducing Weather Bureau pan evaporation in desert areas with similar climate. *

Evaporation from and stabilization of Salton Sea Water Surface

During the Imperial Valley drainage investigations, 1941-52, three Class A stations were established on the shores of Salton Sea, California, This sea was formed as the result of a break of the Colorado River in 1905 when practically the entire flow of the river discharged into the Salton Basin for nearly two years, creating Salton Sea, The basin filled from a minus elevation of about 272 feet to a minus elevation of about 198 feet in 1907. For many years, the excess evaporation over inflow caused the elevation to drop to minus 250 feet in 1923. From about 1925 to January 1, 1954, the surface of the sea rose to 235.8 feet below sea level. This caused encroachment and damage to lands and concerned the

*"Evaporation Study of Silver Lake in the Mojave Desert, California," by Harry F. Blaney, Vol. 38, No. 2, Transactions, American Geophyslcal Union, April 1957, pp. 209-215, illus.

Federal, State, and local agencies. At the request of the State Engineer of California, I made a study of this problem. Based on available data in 1954, on inflow of drainage and flood waters into the sea and pan evaporation, I estimated the average annual evaporation as seventy-two inches, and that the stabilized elevation of the water surface at the minus 220-foot contour would not be reached prior to the year 1980. *

Evaporation of Water at High Altitudes

From 1946 to 1959, I was in charge of Evaporation studies at Class A Stations at five locations reservoirs in the Upper San Joaquin River Basins, California at elevations varying from 410 to 9194 feet above sea level, in cooperation with the Southern California Edison Company. Two reports were published by the American Society of Civil Engineers as Follows:

"Evaporation from Free Water Surfaces at High Altitudes," by Harry F. Blaney, Transactions, American Society of Civil Engineers, Vol. 23, Paper No. 2925, pp. 385-404, illus.

*"Evaporation from and Stabilization of Salton Sea Water Surface," by Harry F. Blaney, Transactions, American Geophysical Union, Vol. 36, No. 4, August 1954, pp. 633-640, illus.

"Evaporation at High Elevations in California," by Leonard L. Longacre and Harry F. Blaney, Irrigation and Drainage Journal, Proceedings, American Society of Civil Engineers, June 1962, pp. 55-65.

"Evaporation from Water Surfaces in Mountains Areas of Western United States," by Harry F. Blaney, Association Internationale D'Hydrologie Bulletin No. 17, Louvain, Belgium, March 1960, pp. 27-35

Water Utilization in Southern Santa Barbara County, California

In 1956, I initiated and had general supervision of a six-year study on consumptive use by irrigated crops and native vegetation and rainfall penetration and return of irrigation water to ground water supply in Santa Ynez River Basin and coastal areas of Southern Santa Barbara County under semihumid climate. Irrigated crops, including alfalfa, vegetable and avocado and lemon trees, There were six climate stations for measuring evaporation, temperature, humidity and rainfall adjacent to Santa Ynez from the coast to Lake Cachuma and one each at Goleta and Carpenteria basins. The results of 1956-62 were published as Utilization of the Waters of the Santa Ynez River Basin for Agriculture in Southern Santa Barbara County, California, by Harry F. Blaney,

Paul R. Nixon, G. Paul Lawless and Ernest J. Wiedman, U. S. Agricultural Research Service, October 1963, 53 pp. illus. (See Figure 8).

Irrigation Water Requirements, West Pakistan

In 1957, I was requested by Royce J. Tipton, consultant for the World Bank, to make a study of the consumptive use and irrigation water requirements for 30,000,000 acres of land in West Pakistan, I asked Wayne Criddle to join me in the investigation. An analysis was made of climatological records, the growing season of Sorghum, cotton, wheat, rice, sugar cane, tobacco and vegetables, and crop yields in the general areas of Punjab, Kotri, Guda-Sukkur and Thai-Tauna.

The reason for the study was that the World Bank was attempting to settle the ten-year old dispute between India and West Pakistan over the division of waters of the Indus River which rises in India, Pakistan had accused India of planning to shut off the flow of tributaries of the Indus River. The Bank was planning to loan money to both India and West Pakistan, The principal dispute was over the amount of water required for the irrigated crops in each country, "Report on Irrigation Water Requirements for West Pakistan," by Harry F. Blaney and Wayne D.

Criddle, April 1957, 58 pp., illus, was used to settle the controversy.

Study of Water Utilization in Israel

At the request of Israel, through the U. S. International Cooperation Administration, I was assigned the task of evaluating the irrigation research program of Israel and to make suggestions for improving research and sprinkler irrigation. Every irrigated area was inspected from February to June 1959. Available data on water supply, irrigation research and water requirements for crops were compiled, and the results reported in "Irrigation Research and Water Utilisation in Israel," July 1959, 100 pp., illus. (See Figure 9).

While in Israel, I gave two lectures on methods of determining consumptive water requirements, and attended the International Farm Convention at Jerusalem where I met Dr. John Hagen of Davis and Dr. Kapland, of the University of California at Los Angeles.

Trip Around the World in 1959

While enroute to assignment on an irrigation study for the U. S. International Cooperation Administration in Israel, I stopped two days in Rome to discuss with the Director of Food Agricultural Adminis-

tration a proposed research on irrigation of rice in Malaya. I then stopped at Athens, Greece, to discuss irrigation problems with an old friend of mine, Professor Christopoulos of the University of Thessalonika.

My wife and I then flew to Istanbul, Turkey where we were met by an irrigation engineer for a New York engineering company. Then we went to Adana where a 300,000 acre irrigation was being planned. They were planning to use the B-C method to determine the monthly irrigation requirements for crops grown in a climate similar to Southern California. I set up monthly consumptive use coefficients (k) for alfalfa, citrus, and other crops, and gave a lecture on the subject to twenty-five Turkish and American engineers and soil scientists. We were then flown to Ankara to attend a dinner given to the Mayor of West Berlin by the Turkish Embassey. The following day I gave a lecture to a group of engineers and was given a copy of my U.S. Department of Agriculture, Soil Conservation Service Bulletin SCS-TF-96, printed in the Turkish language. We then flew back to Istanbul and proceeded to Tel Aviv for ray five-month assignment in Israel.

In Juno 1959, after completing a report on the Israel study, we continued on our trip around the world, visiting and interviewing people in Iran, India, West Pakistan, Bangkok, Hong Kong and Japan on irrigation of rice. Ten days were spent in Japan visiting and studying rice irrigation. Two engineering professors at the University of Tokyo were interviewed. On July 4 we left Tokyo via Japan Airlines and arrived in Honolulu.

About a week was spent in Honolulu and adjacent areas with the U. S. Soil Conservation Service Engineer on a tour of the island, inspecting irrigation practice of sugar cane and other crops and evaporation stations. The Agricultural Experiment of Hawaii was visited, before returning to Los Angeles via United Air Lines.

Tour of Russian Hydro-Irrigation Engineers of Western United States, 1958

While American scientists were making an agricultural tour in the summer of 1958 in Russia, I was tour leader of a group of Russian engineers on an exchange tour in the United States, sponsored by the U. S. Department of Agriculture in cooperation with the State Agricultural Colleges. The Russians arrived in New York on August 12 and departed on September 9, 1958.

The group consisted of five hydro-irrigation engineers and two interpreters, Eugene B. Daniel and Andrew Kersten. The names of the Russian Delegation were as follows:

1. Aleksandr N. ASKOCHENSKIY, Secretary Section of Hydrotechnology and Land Improvement, Academy Agricultural Sciences, Moscow, USSR.

2. Sukhan BABAEV Irrigation Engineer, Ashhabad, TSSR.

3. Ivan I. BUDARIN, Vice-Chief Administration for Water Management Ministry Agriculture, Moscow, RSSR.

Stephen M. PEREKHREST, Director Hydro Institute Ukraine, Chepilki.

5. Nuritdin A. ALIEV, Director Hydro Institute Uzbekistan, Margelan.

Some of the objectives of the tour were:

1. To confer with Department of Agriculture Officials in Washington, D. C. regarding assistance to farmers in irrigation projects.

2. To become acquainted with farmers' irrigation problems and how organizations and Institutions assist them in solving these problems.

3. To observe water utilization, survey planning and scientific research concerned with irrigation development.

To visit United States Department of Agriculture Research Centers and Land-Grant Colleges for:

a. Consultation with officials and specialists in irrigation and drainage techniques.

b. Conferences with extension irrigation specialists regarding methods of disseminating information and providing advice in irrigation and water conservation practices.

c. To review education program through which agricultural engineers are trained for field work.

d. To observe soil and water conservation at research stations and areas including measurements of soil and water under different systems of land management.

5. To visit State Soil Conservation Service offices and projects to observe soil conservation practices established for the use of irrigated agriculture and efficient water use on the farm.

6. To observe how low wet land is reclaimed for farming.

7. To observe the irrigation of cotton and other crops through the application of the various irrigation techniques.

8. To observe the utilization of underground water and recharge.

I met the group at New York Airport and took them to Washington, D. C. to attend conferences for a few days with U. S. Department of Agriculture irrigation specialists and agricultural scientists.

The tour included visits to the State Universities of Illinois, Nebraska, Colorado and Utah, and Texas Technical College [meeting with] the Presidents of the Universities and their agricultural staffs, working on irrigation, drainage and conservation problems.

As "Construction Engineers" they were disappointed in not being allowed to inspect Hoover and other high dams in Western United States, because Russia would not allow American engineers

to visit their high dams.

While in Salt Lake City, Governor George D. Clyde of Utah (also Civil and Irrigation Engineer) received the group twice and reviewed Utah State irrigation history and water problems. Also President Darryl Chase of Utah State University entertained the group at a luncheon. The following day the Russians took a dip in the Great Salt Lake.

Since cotton is a major crop of the 30,000,000 acres of irrigated land in Russia, the group visited Lubbock, Texas, to learn how cotton is grown under irrigation in the united States. The program was arranged by the Lubbock Chamber of Commerce and Board of City Development who greeted us with a red carpet and searchlights as we left the plane at 9:00 p.m. Then they gave us a cocktail party.

At one of the interviews with a newspaper reporter, Mr. Askochenskly, head of the Soviet Delegation, in commenting on the value of exchange tours, said, "Such tours are mutually beneficial, both to us and Americans touring Russia. Such an exchange is beneficial in all fields and serves to better strengthen the friendship between the U.S. and Russia. " This statement expresses my opinion after associating with this outstanding Group of

Hydro-Irrigation Engineers for almost a month.

Engineering Advisory Committees, Los Angeles West Coast Basin

In 1950-51, I was a member of the Engineering Advisory Committee of California, Division of Water Rights, on reference hearings on the lawsuit of coastal cities against the City of Los Angeles, farmers, oil companies and others from pumping water from wells in the Los Angeles

West Coast Basin. The ground water had been lowered to a depth below sea level and the wells were becomin by the encroachment of Pacific Ocean Water. The U. S. Soil Conservation Service made soil and crops surveys and determined the consumptive use of water by irrigated crops and native vegetation in the basin. The results were presented in Cooperative Investigations on Consumptlve Use of Water, West Coast Basin, Los Angeles. U. S. Soil Conservation Service, August 1951 (typed), 58 pp. illus.

San Fernando Valley

In 1958-1962, I was a member of the Engineering Advisory Committee of the California State Water Rights Board, which held hearings for a lawsuit on water rights, Log Angeles River, City of Los Angeles, plaintiff vs. Cities of San Fernando, Burbank and Glendale and other water users in San Fernando Valley. I was appointed to this committee because I was the author of several reports on consumptive use by irrigated crops and on ground water conditions in San Fernando Valley for U. S. Soil Conservation Service and Los Angeles City Department of Water and Power. One of the reports was entitled, The Ground Water Situation in San Fernando Valley, California, by Harry F. Blaney and William W. Donnan, U. S. Soil Conservation Service, 1945, 56 pp., illus. The City of Los Angeles claimed prior water rights on the Upper Los Angeles River Basin

and was trying to charge for the water that the other cities were pumping out of the ground water basin.

Member of Phreatophyte Committees

In I960, I was appointed to a National Committee of five to investigate the problem of control or elimination of undesirable phreatophytes which are consuming and wasting large amounts of water along rivers and marshlands in Western United States. After three weeks inspecting areas of salt cedars, cottonwoods and willows and interviewing many State and federal agencies in the field and in Washington, D, C., a report. Research Needs on the Problem of Saltcedar and other Phreatophytes, was prepared by the Committee to Secretary of Agriculture Benson in January 6, 1961. I was coauthor of this report.

tee on Phreatophytes of the Pacific Southwest Inter-Agency Committee, and chairman of the Subcommittee in 1954. The region covered by these committees Included all of California and the Colorado River, Rio Grande and Pecos River Basins. I have attended many of the quarterly and annual meetings.

American Geophysical Union and National Research Council

I joined the Hydrology Section of the American Geophysical Union as a charter member in 1932 and have

been active ever since. I became a life member in 1965. I served as secretary of the section in 1952-1955, and as vice-president in 1955-1958.

In 1954, I represented the Hydrology Section as a delegate for the National Academy of Sciences and National Research Council to the Tenth General Assembly of the International Union of Geodesy and Geophysics in Rome, Italy, in September 1954, in Toronto, Canada, August 1957, and in Berkeley, California in 1963.

I gave the following lectures at Rome and Toronto:

"Evapotranspiration Measurements in Western United States," by Harry F. Blaney, Tenth Assembly, International Union of Geodesy and Geophysics, Rome, Italy, 1954, pp. 150-160, illus.

"Consumptive Use of Ground Water by Phreatophytes and Hydrophytes," by Harry F. Blaney, Tenth Assembly, International Union, Geodesy and Geophysics, Rome, Italy, 1954, pp. 53-62, illus.

"Monthly Consumptive Use of Water by Irrigated Crops and Natural Vegetation," by Harry F. Blaney, Eleventh General Assembly, International Union of Geodesy and Geophysics, Toronto, Canada, September 1957, pp. 431-439, illus.

"Evaporation and Evapotranspiration Studies, United States Department of Agriculture in the Pacific Southwest," by

Harry F. Blaney, Symposia Darcy, No. 40 de 1'Association Internationale d'Hydrologje, Dijon, France, 1956, pp. 21-26.

Member of American Society of Civil Engineers Committees, Irrigation and Drainage Division

I joined the Los Angeles section of the American Society of Civil Engineers in 1982 and am a Fellow and Life Member of the National Society. I was a secretary of the Water Conservation Committee from 1930-35 end chairman from 1935-1039. Reports were published of the following conference:

and Conservation of Rainfall, which contains twenty-four papers by engineers, agriculturists and foresters, Los Angeles, California, March 27-29, 1930, 128 pp.

vation, papers by twenty-five California engineers and foresters, Los Angeles, California, March 13-14, 102 pp.

3. Proceedings of the Water Conservation Conference. Salt Lake City, July 19, 1938.

I was a member of the Irrigation and Drainage Division Executive Committee from 1952-1957 and chairman in 1958.

I was chairman of the Committee on Water Conservation, 1958-43, and chairman of the Task Group on Consumptive Use of Water for Irrigated Crops and Native Vege-

tation, 1958-1968 (see photo).

I was a member of the Division of Irrigation and Drainage Publication Committee from 1957-1967. In 1939-40, I was Vice-president of the Los Angeles section of American Society of Civil Engineers.

Los Angeles Chamber of Commerce

Prom 1930 to 1958, I was an active member of the Agricultural and Conservation Committees of the Los Angeles Chamber of Commerce. Dr. George Clemens was chairman of the Agricultural Committee, which delved into irrigation, dairy and other agricultural problems of Southern California, George Cecil was chairman of the Conservation Committee, which sponsored conservation of soil and water and fire prevention in the mountain forest and brush areas. These committees met once a month and sponsored semiannual conferences to discuss agricultural and conservation problems, I assisted in preparing fifteen-minute radio talks on these subjects over a local radio station. In 1958, I was presented the Agricultural Committee Award, in recognition of twenty-eight years of outstanding service to Southern California Agriculture through committee participation, by the Los Angeles Chamber of Commerce president.

Consultant on Consumptive Use and Irrigation Requirements

Water Rights--Colorado River Litigation

From 1955-58, I was consultant for the State of California on the consumptive use by irrigated crops and native vegetation and evaporation on the litigation of water rights of the Lower Colorado River Basin, between Arizona, complainant vs. State of California, Palo Verde and Imperial Irrigation Districts, Coachella Valley County Water District, Metropolitan Water District, Southern California-City of Los Angeles, City of San Diego and San Diego County, California, Defendants, United States, State of Nevada, Interveners, State of New Mexico and State of Utah, Parties: Before: Honorable Simon H. Rifkind, Special Master for the Supreme Court of the United States.

Since the 1952 report of the U. S. Bureau of Reclamation on "Water Supply of the Lower Colorado River" described the Blaney-Criddle Method of estimate consumptive use was submitted as an exhibit by Arizona, the U. S. Department of Justice stipulated that the following consultants on the B-C method could be: Karl Harris for Arizona, Harry Blaney for California, and Wayne Criddle for the United States Indian Service. However, the Department of Justice later ruled that, if my testimony was detrimental to the United States, I would be subject to a $10,000 fine and one year in prison. At first, under those conditions, I considered withdrawing as a consultant, until the Attorney General of California agreed to keep me out of jail and pay any fine. Later I recommended Dr. Prank Veihmeyer as a

consultant, since his atmomgter method indicated a higher use of water in Arizona than the B-C method. Pat Dugan of U. S. Bureau of Reclamation and Wayne Criddle gave an excellent description of the B-C method so that I did not have to testify for California, although my testimony was taped twice. My principal duty was to listen and review testimony of witnesses for the opposition and prepare questions for the California attorneys to ask them.

Salinity Problem on Lower Colorado River Area

In 1961-1962, the quality of water delivered to Mexico for irrigating crops in Mexicali Valley from the Colorado River increased from about 900 to 2700 parte per million of mineral salts, Mexico refused to use this salty water, so the State Department of the United States, through the International Boundary and Water Commission, employed me as a consultant and chairman of a committee of three to make field inspections of the areas involved in Arizona, California and Baja California, and to make recommendations of ways of solving the problem. We made a field study of the salinity and drainage problems in Mexicali Valley and the Wellton-Mohawk Irrigation District in Arizona, The salinity of drainage water pumped from the ground water of this district ranged from 4800 to 7200 parts per million. This water reached the Colorado River above Yuma through the Gila River. The confidential report

of our Committee, "Salinity in the Lower Colorado River Area in Wellton-Mohawk Irrigation and Drainage District, Arizona and Mexicali Valley, Mexico," recommended constructing a new channel to bypass the salty drainage water from the Wellton-Mohawk area to a point on the Colorado River below the Mexican Diversion Dam.

Irrigation Requirements, State of New Mexico

From 1963-65, I was consultant to the Pacific Western Land Company at Silver City, New Mexico, which requested a determination of irrigation requirements for twenty farms in the Gils River Basin in New Mexico. Estimates were made by B-C Method of diversion requirements from the river, at the farmers' headgates and at the field for several irrigated crops. This information was needed to adjudicate the water rights for these farms by the State of New Mexico.

The State Engineer of New Mexico used my method and suggested the B-C Method be used to estimate water requirements for irrigation for the entire State for adjudicating water rights in other districts. All irrigated areas in the State were visited and I was senior author of a report, Consumptive Use and Water Requirements in New Mexico, Tech. Report, 32, New Mexico State Engineer, 1965, 83 pp. This report was made in cooperation with the Agricultural Research Service and the Soil Conservation Service of the U. S. Department of Agriculture, New Mexico State University, the U. S.

Bureau of Reclamation, New Mexico Agricultural Experiment Station and the New Mexico Interstate Stream Commission.

Water Situation in Central Arizona Area

In 1966, I was a member of a consulting group for the State of Arizona on the water requirements and the efficient use of water for the Central Arizona Project. Other members of the committee were Dr. Wallace F. Puller, University of Arizona, Dr. Vaughn E. Hansen, Utah State University, and Mr. Robert L. Smith, University of Kansas. About a month was spent in the field and compiling data on water supply from streams and ground water, from reports by the Arizona State Water Commission, University of Arizona, U. S. Department of the Interior and U. S. Department of Agriculture. Each member of the consulting group prepared a separate report. Mine was entitled "Water Situation in Central Arizona Area," which concluded that Arizona was not wasting water and needed an additional water supply.

INTERVIEW: TAPE NUMBER TWO, SIDE ONE

Blaney: I may have said It before, but from 1946 to 1956, I was principal engineer and state research project supervisor for irrigation, drainage and water conservation in California, under the direction of George D. Clyde, Chief of the Irrigation and Water Conservation Division, Soil Conservation Service, USDA.

From 1954 to 1962, I was Research Project Supervisor for the Soil and Water Conservation Research Division, USDA, on consumptive use of water (evapotranspiration) and irrigation requirements studies in the Pacific Southwest.

In January 1962, after forty-four years of service with the U. S. Department of Agriculture, I retired to become a member of the University of California staff as a Fellow in the Irrigation and Soil Science Division with Professor Arthur Pillsbury. In 1965, I was transferred to the Department of Engineering as Research Associate,

Schippers: In all your training during the course of your career, who were some of the outstanding men, in your estimation, that you came in contact with?

Blaney: Well, during my college career, I think Professors Etchevery and Harding in engineering were the best. Etchevery now has a hall in the new Berkeley engineering building named after him. Another one was Professor Frank Veihmeyer, ray supervisor in 1917-18, while I was in Imperial Valley on

silt-investigations, later he was head of the Irrigation Department of the University of California at Davis. After retirement some years ago, a hall was named after him at Davis.

In my government career, W. W. McLaughlin, Chief of the Irrigation Division, USDA, 1928-46, Dr Hugh Bennett, a former chief of the Soil Conservation Service in the U. S. Department of Agriculture, and Dr. Samuel Fortier, former chief of the Irrigation Investigations of the U. S. Department of Agriculture, were outstanding, as was Orson Isrealson, Professor of Irrigation and Drainage at Utah State University. The last chief of our Irrigation and Water Conservation Division of Soil Conservation Service was George Clyde, who resigned in 1954 and is now (1963) governor of the State of Utah.

In California, in the Department of Water Resources, Ed Hyatt, State engineer of California for many years, Robert A. Edmonston, state engineer of California for many years and Harvey 0. Banks, Director of Water Resources, were some of the prominent members of the state organization that I cooperated with in irrigation and water supply studies for more than forty years.

Schippers: On the whole, what was unusual or outstanding about these men?

Blaney: In the case of Hugh Bennett, he organized the Soil Conservation Service in the U. S. Department of Agricul-

ture, and was the author of many publications on the subject. Samuel Fortier was author of a book on use of irrigation water. Orson Iapealson is an author of a second edition of a book, Irrigation Principles and Practice, of which I was senior author of chapter 14, Consumptive Use of Water. This is a standard textbook in most universities in the West.

George D. Clyde, before he entered the U.S. Department of Agriculture service in 1946, was Dean of Civil Engineering at Utah State University at Logan, Utah for many years. In 1954, he was appointed, as Commissioner of Water and Power for the State of Utah, After several years in this position, he was elected governor of Utah and is serving his second term. He is a civil engineer, and is very active in promoting the storage projects in the upper Colorado River Basin. Professor Etchevery, who taught irrigation engineering at the University of California at Berkeley for many years, was author of three volumes of textbooks on use of irrigation water, irrigation engineering and drainage. Also, former Professor Sidney Harding, now a consulting engineer. These have been widely used textbooks in the universities.

Schippers: Would you say all these men were dedicated engineers? Did they solve the problems that they were involved in, or were they more or less doing a Job?

Blaney: Well, I would say they were dedicated engineers because most of them could have gone out as consulting engi-

neers, which they later did, and made much more money than they were making either working for the State of California or the State of Utah or the federal government.

Schippers: What was the inducement for them to stay on these projects?

Blaney: Well, they were interested in the water supply, drainage, and water requirements for irrigated agriculture. I think that was the main reason. It's kind of hard to say.

Schippers: In your own life what has it meant?

Blaney: During the depression, I had the chance to be employed by a private company at about twice the salary I was getting from the federal government. But I was more Interested in irrigation and water problems of the west, and the other Job wasn't entirely connected with irrigation but more with hydraulics.

Schippers: In other words, your interacts really controlled your lifework more than, let's say, desire for money?

Blaney: Well, take the situation here now (1963)--I have the title of research fellow with the University of California, and when I retired in 1962 from the U, S. Department of Agriculture, they gave me a title of collaborator. Both these appointments have no salary attached to them. I could have set up a consulting engineering office and made a hundred dollars a day on irrigation projects. In fact, I have on occasions, if they didn't take too much time,

accepted one or two consulting jobs. But I'd rather stay part of the government and the University of California where I can keep in touch with the research in irrigation, drainage and water conservation, rather than spend most of my time on consulting work.

Schippers: Would you say that this is rather true of the men in your field as a whole?

Blaney: I think most of the wen in irrigation and drainage of the U. S. Department of Agriculture after retiring have worked half time for the department without pay rather than go out into consulting work. This is also true for the professors of the Universities. However, if they are offered consulting work which they're interested in for short periods, they have done some of that work. I think on the whole, though, most of the men who have retired have worked part time for the government and the University of California without pay.

Schippers: In other words, there's a real spirit of scientific inquiry involved, or curiosity, or whatever you might call it?

Blaney: Well, I guess that's right.

Schippers: What have been some of the jobs in your career that have been highlights?

Blaney: Well, I think in research work in government, and with the University, you're given a research problem to solve and allowed a free hand. You also have an opportunity

to study some large projects like water utilization on the Pecos River and Rio Grande in New Mexico and Texas, and the Colorado River water problems in the seven western states. Also, there has been a chance for foreign assignments which are very interesting, such as in Cuba and Israel,

Schippers: There must be some real sense of accomplishment when you see some of these things applied, and some of your findings utilized.

Blaney: That's true. You find that many of my findings have been referred to in publications on engineering and in technical magazines. And the formula which was developed for determining consumptive use of water and irrigation requirements is now being used all over the world, and I get letters almost every week asking for the latest information on the subject. The fact that I have some one hundred articles or reports published is also one of the rewards of research in use of water for irrigation. Of course, the fact that you are chairman of the national committee on Consumptive Use of Water and Water Conservation of the American Society of Civil Engineers, and you were chairman of the Executive Committee of the Irrigation and Drainage Division, and you look back on your associations with other engineers and scientists who are working on similar projects, either for the government, state, university or private institutions is a satisfaction.

Schippers: I wonder if we could just have a general commentary on your appraisal of the water situation in the west, a kind of a general approach, what you think some of the problems are now.

Blaney: Well, of course, the biggest problem is to make use of the limited water supply in the arid and semi-arid western states, and foreign countries like India, to improve the present irrigation practice in many areas, to increase the efficiency of irrigation and food production. In some areas only about one-third of the water diverted for irrigation is actually used by the plant for transpiration and evaporation from adjacent soils. These efficiencies at Farm Head Gates, range from about forty to seventy-five percent and by lining canals and putting water in lined ditches or underground pipe systems, efficiency in many areas that are only fifty percent at the present time could probably be raised to seventy percent. It is estimated by some authorities that at least fifty percent more land could be irrigated with improved irrigation practices with the present water supply.

All the cheap water supplies, for most domestic and irrigation purposes, have been developed and water which in the early development would cost only a few dollars per acre-foot is now reaching fifty to sixty dollars per acre-foot under the new developments.

Schippers: On the whole, are you optimistic about water development in the future?

Blaney: As far as irrigation is concerned, the future isn't very bright for new developments. Water which has formerly been used for irrigation of crops in southern California and Arizona in some instances has been purchased or condemned for municipal and industrial purposes as the land has been put into residential homes or industrial plants. This has not been so much the case in central and northern California and other western states. But they are developing throughout most of the coastal area in California and central Arizona.

Schippers: In your preparation of these reports, in what way does the official status of them affect your approach to the study?

Blaney: Usually the reports that I've made have been at the request of federal, state or local officials. They've been made to report the facts for solving a problem. Perhaps the beet examples of that are three I can name right now. Now the Rio Grande, it was a question of determining the past, present, and future use of water for some thousand miles, of lands adjacent to the river which were being irrigated in Colorado, New Mexico, Texas and Mexico. There was controversy as to the use of the water by the states of Colorado, New Mexico and Texas, and a master was set up by the U. S. Supreme Court to obtain the facts. They didn't have enough facts, and so the hearing was deferred until

we made a study of the water utilization of the Rio Grande, and the facts were presented to the master who was representing the U. S. Supreme Court. The three states of Colorado, New Mexico and Texas finally got together and formed a compact commission which included an engineering advisory committee and a group representing each state which usually was the state attorney general and state engineer of each state. The water distribution was finally settled by the compact agreement which was signed by the three states.

The same applied to the Pecos River Joint Investigation, 1939-41, by a National Resources Planning Board, when I was in charge of the use of water studies in Pecos River Valley in New Mexico and Texas. As a result of this survey, an estimate was made of the past, present, and the future use and a compact signed by the representatives of the two states and approved by Congress. These compact commissions are still operating and take care of any disagreements* that occur over the use of water entitled to each state.

In connection with the Lower Colorado River Basin, there have been forty years of controversy over water rights

*Harry F. Blaney and Wayne D. Criddle, "Determining Water Requirements for Settling Water Disputes, "Natural Resources Journal, (May 1964), pp. 29-41.

that have been decided recently by the U. S. Supreme Court after some six years of facts being presented in testimony, by the states of Arizona and California and the federal agencies involved, as well as the states of New Mexico, Utah, and Nevada.

Schippers: In other words, sometimes the compilation of facts, even though objective, is open to dispute?

Blaney: Yes, the facts were presented and some of them were open to dispute. The actual rates of the use of water, for example, which were determined by studies which I made in cooperation with our representative in Arizona and the State Engineer of California, were accepted, and they were based on the actual water used by the states, but the question involved was whether there was sufficient water to satisfy additional lands to be put under irrigation or even to satisfy the present use, because the average of stream flow measurements of 17,000,000 acre-feet per year made thirty years ago or more showed a higher amount of water available than is now available. So the problem is to allocate a shortage of water to the various states involved.

Schippers: But your publications on use of water have been relied upon as sound?

Blaney: Yes, it was stipulated by the U. S. Department of Justice, which entered the California-Arizona lawsuit to protect the water rights of Indian reservations, that co-authors' report (one is located in Arizona and one who is

located in California) and the empirical formula which was developed by the senior officer and the present state engineer of Utah, who represented the Indian Service, be used. Now, Arizona, California, and the Indian Service stipulated that the rates of consumptive use that were determined from actual measurements and transferred by formula to all parts of the lower Colorado Basin would be as accurate as could be obtained.* The report used was Appendix B to the U. S. Bureau of Reclamation report, The Water Supply of the Lower Colorado Basin.

The Bureau of Reclamation determined the area of land irrigated in each of the states, and also the area of native vegetation, and applied the rates to these areas to determine a total amount of water consumed by irrigated lands had native vegetation in acre-feet. As you probably know, rates of use of water are given in acre-feet per acre and, in order to get the total, it is necessary to have the area of the land involved.

In the case of the Upper Colorado River B sin, in 1948 the five upper basin states decided they would like to have determined the amount of water used by each state and for each tributary to the Colorado River. The empirical

*Harry F. Blaney and Karl Harris, Consumptive Use of Water Rates in the Lower Colorado River Basin, U. S. Soil Conservation Service, 1952, 88 pp.

formulas developed by Blaney and Criddle were used at the request of the Upper Colorado Basin Compact Commission, and Criddle and I spent several weeks inspecting all the irrigated and native vegetation areas *in* the subbasins of the Upper Colorado River Basin. We prepared a report on rates of consumptive use by irrigated crops and native vegetation and evaporation from free water services by the B-C method, and it was submitted to the Upper Colorado River Basin Commission. The states each furnished the area of irrigated land, and the rates developed in acre-feet per acre were applied to these areas and the total amount of water used by agricultural crops in each state was computed in acre-feet.

The study was completed in the summer of 1948. The five states ratified the amount of water set up as a result of this study for each state early in 1949. And in the summer of 1949, the compact that was entered into by the upper basin states, appropriating the water for each state, won the approval of Congress. Thus within about a year's time, the states of the Upper Colorado River Basin were able to divide the water, without any lawsuits. This included the states of Utah, Colorado, New Mexico and Wyoming, and a small portion of Arizona which has the Indian reservations in the Upper Colorado River Basin. As a result of this, there has been no long controversy in the Upper Basin as there has been in the Lower Colorado River Basin.

Schippers: Do you think in the future that litigation can be avoided by more exacting studies?

Blaney: Well, under certain cases, there may be minor disagreements on the Rio Grande, the Pecos River, and the Upper Colorado River.

In southern California, there's still litigation, for example, on the Santa Ana River. Some thirty years ago there was litigation between San Bernardino, Riverside and Orange Counties, and also between the cities of San Bernardino and Riverside on the use of the waters of the Santa Ana River. Within the past few years, Orange County has sued the City of San Bernardino and the City of Riverside, I think, but I'm not sure, and has compelled the City of San Bernardino to stop pumping water from the Santa Ana River Basin.

The result is that the city of San Bernardino asked to join the Metropolitan Water District of Southern California in order to obtain enough domestic supply. They also have condemned some of the mutual water companies that were furnishing water for irrigation. They have that right for domestic use.

One of the most famous cases is the Fallbrook Case on the Santa Margarita River in which some years ago two of the big ranches on the river, the Vail Ranch and the Santa Margarita Ranch, went to court on the uses of the water of this river. One ranch was about 60,000 acres in

Riverside County and the other was over 200,000 in San Diego and Orange Counties. A million dollars or more were spent on lawsuits hut really didn't prove much. The result was that, after over a year or more, the owners of the Santa Margarita Ranch, who were the plaintiffs in the suit, had to turn over part of their land to lawyers and engineers to pay for their fees.

Later on, during the Second World War, the U.S. Government, through the Navy, took over the land in San Diego County and sued some 5,000 users, small users, ranging all the way from churches to irrigation districts, to claim that the United States had paramount water rights. This lawsuit has gone on for several years and has finally been settled by the U.S. District Court. But (1963) there's a possibility that the U.S. Department of Justice will appeal the decision and take it up before the United States Supreme Court. So any place where you have a shortage of water, there are going to be lawsuits.

Schippers: And facts alone aren't going to decide it?

Blaney: No, the facts alone are not going to decide it as politics be evolved.

Schippers: On the whole, would you encourage, shall we say, a more centralized jurisdiction for water problems?

Blaney: Well, on state streams in most of the western states, it's in the constitution that the waters belong to the state and are to be administered by the state.

In California there has been either a state water rights board or a state water rights commission that is supposed, after the suits are filed, to obtain the evidence for the court and make recommendations.

Most recent large cases have been investigated first by the water commission. The City of Los Angeles, for example, has sued the cities of Glendale, Burbank, San Fernando, and some of the large landowners who are using Los Angeles River water by pumping from the San Fernando valley underground basin. For some five years the City of Los Angeles has billed the City of Glendale for some $60,000 or more a year for the amount of water they have pumped out of the Upper Los Angeles River Basin, because some fifty years ago, it was decided by the courts that Los Angeles had pueblo water rights, which are of the best kind of water rights in the state. And because of that they could prohibit others from pumping water from the San Fernando Valley basin.

The city brings water down from Owens valley at a great expense, and surplus waters are spread to recharge the under-ground basin. Before the water was brought into San Fernando Valley in 1912, the acreage irrigated land was small. Later, there were some 75,000 acres of irrigated land in the valley. This has been reduced since that time to about 10,000 acres of irrigated land. But during the period when the water was applied for irrigation, about

twenty-five percent of the water was being transported by the City of Los Angeles for irrigation was returned to the groundwater basin because of over-irrigation. This case has been before the Water Commission engineers for some four years and has cost probably a million and a half dollars of those who were involved in the suit. As the results of my studies of consumptive use and water requirements from 1925 to 1941, I was consulted on this lawsuit and these data were used by the City of Los Angeles and others. The State charges the contestants in proportion to the amount of water they're using. It hasn't been settled yet in 1963. It may be appealed to the state supreme court or maybe higher courts, U. S. court.

Another case which I was on was the West Los Angeles Ground Water Basin, which included all the land from Long Beach to Beverly Hills adjacent to the Pacific Ocean. 3 This involved some 50, 000 wells which were pumping water for irrigation, domestic and industrial purposes. This suit was brought by Manhattan Beach and some of the other cities along the coast, claiming (which was fairly substantiated by records) that, because of overdraft on the groundwater basin by pumping the water down below sea level, ocean water was seeping in and damaging wells in these cities. The result was that pumping has been restricted and water from the Metropolitan Water District is being used and also reclaimed sewage is being used to recharge

this Los Angeles West Coast Basin. There again, the consumptive use of water was the big factor in this litigation, and I made an estimate of use of water by B-C method and from other data.

Schippers: In other words, we could just about sum up by saying that obtaining water is going to be increasingly more the American pursuit of life, isn't it? [Laughter]

Blaney: Well, it surely is in California and Arizona. Now, there's another area they call the Central Coastal Basin, that includes part of Long Beach, the Lower San Gabriel River Basin of both Los Angeles and Orange Counties, and there salt water is coming in because there is an overdraft of the ground water basin. They're getting together, though, and instead of bringing it before the court, they're going to try to set up a committee which will adjudicate their own water rights. And what is involved there, too, is that Orange County is spending a quarter of a million dollars a year buying Colorado River water from the Metropolitan Water District to recharge their groundwater basin1 The Los Angeles County Flood Control District has purchased some Colorado River water to use for what we call water spreading to recharge those underground basins, so as to prevent the further intrusion of salt waters from the ocean and ruining those ground water basins. Also, they're going to spread some reclaimed sewage water to help solve the problem.

Since Arizona has won the Colorado suit, California will lose about a million acre-feet of water per year. The Secretary of the U. S. Department of Interior has suggested transporting water from Northern California into the Colorado River. It has been predicted that the Metropolitan Colorado River Aquaduct, which cost some $500,000,000, may become dry in years of low precipitation. Like the explosion of population, the water shortage is becoming more and more of a problem.

Of course, you know, the State of California is planning to transport about 1,200,900 acre-feet per year of water from the Feather River Project to take care of southern California water needs. And if it hadn't been for the Colorado River Aqueduct and the extension of that Aqueduct to San Diego County, in dry years they would have had to haul in water to the City of San Diego by tank cars. It was Just that serious during the war when President Roosevelt, by executive order, required the Metropolitan Water District to furnish water to San Diego County without making the county Join Metropolitan Water District. Then the U. S, Navy and the U. S. Bureau of Reclamation had started to build an aqueduct to bring Colorado River water from San Jacinto to San Diego. When the war was over it was only half completed. Then the only way they could get the water to San Diego County was to Join the Metropolitan Water District of Southern California and have the District complete the San Diego Aqueduct, which

they did. And they compromised on the cost of the Aqueduct by agreeing to pay so much per year for thirty years on back taxes that had accumulated from the time the Colorado River Aqueduct was built.

ADDENDA

Honors and Awards

Superior Service Award and Silver Medal; U. S. Department of Agriculture, 1951.

Distinguished Service Award, California Chapter, Soil Conservation Society of America, 1961.

Chamber of Commerce for 28 years of outstanding Service to Southern California Agriculture, 1958.

John Deere Gold Medal Award for distinguished achievement in the application of science and art to the soil, 1966.

Royce J. Tipton Award for pioneering research on evaporation and transpiration, and for the development of an outstanding method for predicting the consumptive use of water by native vegetation and irrigated crops, 1966.

Honorary Member of the Creek Committee on Irrigation and Drainage of the International Commission on Irrigation and Drainage, 1967.

Member of The Society of Sigma Chi, California. Institute of Technology Chapter.

A NOMINATION FOR THE

ROYCE J. TIPTON AWARD

ASCE - 1966

HARRY F. BLANEY

Reason for nomination:

Mr. Blaney's outstanding achievement has been in the field of evapotranspiration and consumptive use of water. Inthe arid area of the world, one of the prime considerations to be made in the development of water supply projects is how much water will be needed per unit of land developed. Dr. Blaney has developed a formula for computing unit consumptive use of water needed for various crops. The formula is known widely as the Blaney-Criddle method of computing consumptive use

Mr. Blaney is internationally famous and a world authority on consumptive use of water. His research work has carried him into most of the states of the West. He has also acted as a consultant on water problems in Israel, Pakistan, Cuba, and Puerto Rico. He has published over 50 technical bulletins, handbooks and textbooks on irrigation, evaporation, and consumptive use. Some of his publications have been translated into Italian, Greek, Spanish, Hebrew, Turkish, and Japanese.

In the United States, Mr. Blaney has been called upon to make research studies and investigations in almost every state in the West. His outstanding and original work on consumptive use and water balance in California led to his detail to the Rio Grande Investigation in 1936. Here he was placed in charge of consumptive use of water investigations for the National Resources Committee.

In 1939 he headed up the study on consumptive use in the Pecos Valley of New Mexico and Texas. Subsequently he was made senior member of the team to determine unit consumptive use rates in the upper and lower Colorado River Basin. The results of this study were used to adjudicate the waters of the Colorado River between the States of California, Arizona, Utah, Nevada, Colorado, New Mexico, and Wyoming.

"Mr. Consumptive Use"

honored for research

One of the most honored members of the engineering dept. research team is a gentleman called Mr. Consumptive Use.

But he has accepted most of his awards — most recently the Royce J. Tipton Award and the John Deere Medal — under the name Harry E. Blaney.

Blaney, nicknamed Mr. Consumptive Use after the nature of his research, has been associated with the U. S. Dept. of Agriculture since his graduation from Berkeley in 1915. Now, after his retirement, he has joined the staff here as a research assistant in the engineering dept.

The work which earned him several awards — and the nickname — is a plan for determining consumptive use of water and irrigation water requirements.

His plan involves the measurement of the amount of water used by crops (consumptive use) and the amount of water the crop will need in order to grow (irrigation requirements).

Irrigation planning

The reason for the formulation of this plan, Blaney said, was simply that farmers and the irrigation planners wanted to know just how much irrigation was needed without having to measure each time.

In order to fulfill this plan for the farmers, Blaney, working for the Dept. of Agriculture in cooperation with the University, developed a mathematical formula to determine the approximate amount of water needed for each kind of crop.

This formula has been employed in over 80 separate state and national agricultural bulletins in this country as well as having been used in many foreign countries.

Sunshine, hours, temp

The plan, first used in 1940, involves a formula correlating the amount of sunshine, the monthly temperature, the hours of daylight in one month and arriving at a figure which is the relation between these factors and the measured use of water, Blaney said.

Blaney has worked in the field of irrigation engineering since his graduation from Berkeley. He majored in irrigation engineering, he said, because, "in 1915 irrigation was the biggest California water problem."

For 45 years he has worked in this field for the Dept. of Agriculture. Last year the American Society of Civil Engineers honored him with the Royce J. Tipton Award and the American Society of Agricultural Engineers honored him with the John Deere Medal.

Old system

When asked about the future of the irrigation programs in California under Reagan, Blaney said, "Reagan has gone back to the old system of appointing an engineer to the Dept. of Water Resources. Under Brown, there were business people, and politicians in these offices who just didn't know enough about it."

Addendum to: -

ORAL HISTORY OF CALIFORNIA WATER RESOURCES DEVELOPMENT

Reports Compiled

by

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and

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United States Department of Agriculture

Water Resources Center
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Los Angeles, California
July 1968

Publications of Harry F. Blaney

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