

United States
Department of
Agriculture

Forest Service

Engineering Staff

Washington, DC

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The History of Engineering in the Forest Service

(A Compilation of History
and Memoirs, 1905–1989)

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Oscar Charles Merrill, 1874-1951.

Oscar Charles Merrill, best known as O.C. Merrill, was born in Manchester, Maine, on July 30, 1874. He attended Bates College, B.A. degree, 1899; Massachusetts Institute of Technology, B.S. degree, 1905; and Bates College, honorary doctor of science degree, 1925.

O.C. Merrill taught civil engineering at the University of California in 1905-1906 and was water power investigator in Washington, Oregon, and California in 1906-1908.

O.C. Merrill joined the Forest Service in 1909. He was Chief District Engineer, 1910-1913, and the first Washington Office Chief Engineer, serving from 1913 to 1920. He left the Forest Service in late 1920 to accept an assignment as Executive Secretary for the Federal Power Commission.

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Foreword

Part I

Cold records in the Archives often do not contain sufficient background or color to provide an adequate basis for writing history. They will be of greatest value when supplemented by personal observations of men who have made history. For this reason, selected retirees of the Forest Service have been asked to write about their experiences. These memoirs are included in this compilation.

It would have been impractical to ask all retirees to contribute to this work. Therefore, people who covered a span of history or who were involved in activities that were unusual episodes were selected.

The manuscripts submitted were not edited except for obvious mistakes or typographical errors. Some were shortened in order that the overall work could be contained in one volume. However, the full text has been placed in the Historical Library of the Division of Engineering, Washington Office. These manuscripts will be made available to researchers or people interested in forest history.

Copies of this compilation will be sent to all participants and to each Region for its historical record.

This first attempt to record the past will be followed up in succeeding years. (See section below.) It is hoped that those who receive copies will be stimulated to submit corrections or detail to add to this record.

Except for mention of their work in "Brief History of Engineering" (page 1), research engineers are not included in this compilation. A record of their exploits is available at the Forest Products Laboratory in Madison, Wisconsin. Some of the early workers were:

McFarvey Cline: First Director of the laboratory, who started research in engineering properties of wood in 1906.

Harry Tieman: Pioneer in wood physics and in kiln drying of wood and its effect on strength of wood, who came to the Division of Forestry in 1900.

A.L. Heim: First work on strength of wood started in 1906.

R.P.A. Johnson: Started with the Forest Service as a land surveyor. Came to the laboratory in 1918. On retiring, in 1958, he was Division Chief, Wood Engineering Research.

These men, along with J.A. Newlin, L.J. Markwardt, George Trayer, and T.R.C. Wilson, led in developing a scientific basis for use of wood as a structural material. All were graduate engineers.

Part II

The above foreword and all of Part I of this volume were published by the Forest Service in the late 1960's. Part II was submitted from the contributing authors during 1989 and early 1990. As can be seen, Part II overlaps chronologically with Part I; chapters within each of the two parts also overlap. However, we tried to order Part II as chronologically as possible according to the year in which the author begins the piece.

The editing was minimal. We made the chapters consistent, using GPO and Forest Service Engineering styles and format as guides. Sometimes, spellings of people and places cannot be verified and can only be left up to the authors' recall. We did not opt to edit chapter titles so some are identical within Parts I and II.

As in Part I, Part II is a collection of various disciplines within Engineering and various geographic locations to provide the reader with a vast overview of Engineering's history, fascinating and unusual anecdotes, and wide coverage of what the Division did and does now.

Part I: 1905–1969

Brief History of Engineering in the Forest Service

J.J. Byrne

In 1905, F.G. Plummer was transferred to the Forest Service from the Geological Survey. He did extensive compilation of statistical and map data and wrote the first descriptions of forest conditions in many of the western National Forests. It was in this era that the Forest Service employed many surveyors to locate and mark forest boundaries. This marks the first time that engineering-related activities were carried on in the Forest Service. This was the era of Gifford Pinchot.

In late 1906, the Washington Office added a new section called Reserve Engineering. Mr. W.E. Herring, formerly of the USDA Irrigation Division, headed this work. He was charged with "general supervision of all engineering work on reserves done by private interests or by the Forest Service." Ten civil engineers were hired that year, along with "telephone experts" and several draftsmen.

In 1907, an Act was passed stating that "the Forest Reserves shall be known hereafter as National Forests." It was also in 1907 that a central research office was set up in Washington. During this period the Forest Service set up cooperative projects at Purdue, Illinois, California, Washington, and Yale to do engineering research and to learn more about the structural properties of wood.

In 1908, a former District organization was set up similar to the present Regional organization. Mr. Herring became District Engineer while O.C. Merrill was placed in charge of the Washington Office Engineering activities.

In 1910, action was started to develop the National Forests. There were constructed 320 miles of road, 2,225 miles of trail, 1,888 miles of telephone lines, 65 bridges, 563 miles of fence, 181 miles of fire line, 464 cabins and barns, and 51 corrals.

Also, by 1910, the Forest Service had become an important agency for the issuance of permits for water power development. That year it issued 171 such permits.

In 1911, two hydroelectric engineers were hired to assist in water power work. They were two of the outstanding hydroelectric engineers in the country at that time.

It was also in 1910 that the Forest Products Laboratory was established on the University of Wisconsin campus. Cooperative work on engineering

properties of wood, along with other Forest Products research, tree identification, timber physics, wood identification, and timber preservations were started. It was fortunate that the work on wood was started at this time because by the time World War I commenced, considerable knowledge of wood structural properties and techniques for wood drying had been developed by this Laboratory. Gunstocks were dried in days instead of months. The air fleet of that war utilized a wood structural framework of Sitka spruce. The wood scientist and engineer of those days were as important to the war effort as a nuclear physicist of today. Wood research was greatly accelerated to take care of defense activities. Engineers and draftsmen from all Districts were called to Madison to assist in design.

The first world war had another effect. It change the status of the electrical power industry in the United States. The Chief Engineer of the Forest Service, O.C. Merrill, was one of the leaders in recommending that some order be brought out of the actions of various Federal agencies connected with power development. He recommended that a Commission be set up composed of the Secretaries of Agriculture, Interior, and War, together with four people outside the Government. This recommendation was accepted and culminated in the Federal Power Act of June 10, 1920, which created the Federal Power Commission (FPC). O.C. Merrill became the Executive Secretary of the Commission, and T.W. Norcross came in from his District Engineer position in Region 2 to head the Division of Engineering for the Forest Service. There was no provision for a Commission staff, so each department detailed engineers to the Commission for an office staff, and also field engineers made necessary field investigations in their respective jurisdictions. Within 5 months after the Commission was organized, over 100 applications, totaling approximately 8 million horsepower, had been received. This action by the Forest Service to handle the entire engineering work of the Commission for projects on National Forest lands continued until 1936. Forest Service Engineers were transferred to FPC and formed the nucleus of the engineering staff of the Commission in the top-level positions. To this day, investigations are carried out by Forest Service engineers to determine whether proposed power projects will be inconsistent with National Forest interests, that the designs are adequate, and that the plans are suitable for full development of the power site.

The Act of March 4, 1912, provided that 10 percent of the receipts from the National Forests would be available for road building. Road building was accelerated.

What was to become the first use of radios in the Forest Service occurred at the Baseline Ranger Station, Apache National Forest, Arizona, in 1916. This Station was isolated without other means of communication, so the Ranger installed his own spark gap transmitter and receiver to communicate with the station at Clifton, 23 miles distant by air. The Ranger Station was in a canyon bottom, and the antenna extended 1,600 feet from one canyon wall to the other.

In 1920-21, the Forest Service cooperated with the Army for use of radios in airplanes, and this equipment was used in spotting and reporting forest fires in Montana, Idaho, and California.

By the early 1930's, the low frequency SPF (3 to 4 mc) was coming into common use throughout the Forest Service. By 1933, amplitude modulation sets using frequencies from 30 to 300 mc were in use. Following World War II very high frequency sets using frequency modulations came into use. Since 1953, all new radios have been FM using the 162 to 174 mc bands.

Engineering work of the Forest Service continued at a sustained pace with minimal appropriations until the Civilian Conservation Corps (CCC) was established. During this time, many innovations were started. The need for adequate maps for management purposes still continued to be a big handicap, and methods were being examined to do mapping by aerial methods. Jim Yule in Region 1 and Lage Wernstedt in Region 6 were among the pioneers. By the time CCC came around, Jim Yule was producing strip maps from aerial photography. Jack King was using oblique photography to improve map making. In 1930, the Forest Service cooperated with the Navy and Interior to make an aerial survey of southeastern Alaska.

The CCC program, starting in 1933, allowed Forest Service engineering to become "big time." Although the Forest Service had been regarded as one of the outstanding water power engineering agencies, the amount of funds for works of improvement had been slim, and very few engineers were available in field offices for this type of work. Most of the engineers who were employed outside the hydroelectric field were called chief surveyors because cadastral engineering was an important activity.

The CCC supplied over a quarter million young men to do conservation work. Funds were also available to supplement corpsmen labor. Hundreds of engineers were employed in the year 1932-33 to design and supervise construction of roads, trails, bridges, buildings, utility systems, communication systems, campgrounds, and watershed improvements. Equipment management activities became a necessity because not only vehicles, but also heavy construction equipment was needed.

At the time the CCC program was inaugurated, Forest Service engineers were in the process of developing a system for location, design, and construction of what was then called "truck trails." (Truck trails were largely for fire protection needs since at the time very little timber was cut on National Forest lands.) Although funds were available that year, they were limited, and cost per mile was a major consideration. The Forest Service developed a system of surveys including the use of hand instruments, such as compasses and Abney levels and a system of survey known as "contour method" of road staking. Forest Service engineers conceived the idea and worked in collaboration with industry to develop the first practical bulldozer. It was fortunate for the Forest Service that in the early 1930's the Great Depression had "stalled" engineering work and very many high-level engineers were available for the asking.

The advent of World War II brought a pause in these accelerated engineering works. Many of the CCC boys trained in heavy equipment operations, along with Forest Service engineers, were a bulwark of the Seabees and other construction activities of the Defense Department. (Among the first persons captured on Guam was a shovel operator trained in Region 1.)

Because of the shortage of critical minerals such as chrome and tungsten, the Government, through the Defense Material Corporation, contracted with mining companies to develop known deposits, some of which were on National Forest lands. Failing to get help elsewhere, these companies asked the Forest Service to build access roads. Using skilled construction people and equipment acquired during the CCC program, the Forest Service moved in and met deadlines. For example, an 11-mile road to a chrome deposit was opened up in rough mountain terrain in 30 days. This road was to a standard adequate for moving heavy equipment to the mine. It was later improved.

Because of the demonstrated ability of the Forest Service to organize and handle emergency procedures, the Forest Service was selected to handle the guayule rubber project in the Southwest. (Guayule was a natural shrub in this area containing up to 20 percent natural rubber and resembling the appearance of sagebrush.) A major part of this project involved the construction of labor camps with their complement of utility and sanitary systems, irrigation systems for nurseries and plantations, seed treatment plants, research and development facilities, equipment research shops, and rubber extraction mills. This project extended, in a belt about 100 miles wide, along the boundary of the United States from Sacramento, California, to Brownsville, Texas. This project was a great challenge to the Forest Service engineers who engaged in it. About 2,000 acres of overhead sprinkler system were built for nursery irrigation, 35,000 acres were put under irrigation for field crops, and labor camps to house 10,000 laborers, research laboratories, seed treating plants, two rubber factories, and many other engineering works were built. It was also satisfying to know that near the end of the war, natural rubber was so scarce that the Rubber Reserve Corporation requested that rubber be extracted from 35,000 acres of guayule planted during the project. This rubber was being used for the inner plies of heavy duty truck tires and for the sandwich material in bullet-proof gas tanks used in aircraft—synthetic rubber was not suitable for these purposes. At the time the war ended, two rubber extraction plants were operating, and plans were on the table for four more extraction plants. Approximately 6 million pounds of rubber were dispatched to rubber processing plants by the war's end.

Another activity of the Forest Service that contributed to the war effort was the War Mapping Project. Among other areas, the Forest Service mapped the northwestern part of California and strategically important areas in the East for the military and was responsible for the development of all maps used in the Iwo Jima campaign. They were working on mapping the southern coast of China and the Japanese homeland when the war ended. This group received a citation from the Secretary of the Navy for its effort.

The Forest Products Laboratory was again called on to accelerate its research and development activities. Techniques were developed for gluing stressed skin shapes for the "mosquito" bomber used by the British to defend Britain. Gluing methods were developed for laminated keels for wooden minesweepers, which were in demand to counter magnetic mines used by the enemy.

Plastics had been introduced at this time, and the Defense Department wanted information on engineering properties and methods of manufacture of composites using wood and either plastics or metals in structures. Because

of expertise developed by the Laboratory on sandwich type of construction, it was also asked to do analytical work and develop methods of design and stress shapes using stainless steel and aluminum for aircraft structures. The Laboratory also worked to improve shipping containers for articles and materials of war. It is estimated that as a result of its work in packaging research, the need for at least 30 liberty ships was obviated. It is interesting to note that many of the developments of the Laboratory during the war are in commercial use today.

In 1947, Mr. Norcross retired as Chief, Division of Engineering, and was succeeded by Mr. A.P. Dean.

After the war, the accelerated increase in population and a lag in house construction during the war caused tremendous demands for new housing. Although the war effort had caused great acceleration of demands for National Forest timber, these demands were greatly increased to satisfy housing needs. Timber in sufficient amounts was not available on non-Federal lands. Timber access roads needed to be considered to open up virgin stands within the National Forests. More engineers and engineering technicians were employed. This pressure for National Forest timber has continued to increase to this day.

During this period after the war, the Forest Service was designated as one of the standard mapping agencies of the Government, and appropriations were provided for stepping up this program. The people trained during the war period provided a nucleus for the formation of a photogrammetric service center equipped to produce standard topographic maps, keep abreast of rapid advances in the field of photogrammetry, provide expert advice to the various field offices, and serve as a training center.

In addition to complementing the efforts of major mapping agencies, advances have been made in the use of air triangulation techniques whereby the amount of costs of field surveys have been lessened. Forest Service leadership in the use of photogrammetry, in connection with public land surveys, resulted in the Bureau of Land Management approval of the first resurvey of a township employing photogrammetry. Advances have been made in the employment of photogrammetry in the development of terrain data for route reconnaissance and road design. Still further advances in the application of photogrammetry to all phases of forestry engineering are contemplated through the use of analytics and automatic coordinatograph procedures.

Forest Service engineers played an important part in the surveys and plans for upstream river basin flood control program between 1937-42, and 1946-53, under the Flood Control Act of 1935 as amended.

In the years after the war to the present time, other continued technological improvements have been made in engineering activities of the Forest Service. For instance, the use of computers is common in development of terrain data and for road and bridge design.

The Forest Service hires many mining engineers and geologists in connection with mining activities on National Forest lands to lease for true claims of the Mining Act. This activity was comparatively small until 1955 when the

Multiple-Use Mining Act was passed. The main activity of mining engineers and geologists is to ascertain whether minerals are available in amounts and compositions that would allow claims or leases to be operated at a profit.

A major program of equipment development and testing was instituted in 1945. The program of Forest Engineering Research was begun in 1958.

In 1962, President Kennedy submitted to the Congress a 10-year program for the development of the National Forests. The time was right, and the whole program of the Forest Service was expanded to a substantial degree. This brought the need for many more engineers than were ever employed in the past in all activities of National Forest administration and in research.

The Forest Service found that its engineering work was suffering from "growing pains," and it was decided to make a detailed study of the engineering situation, including the use of engineering skills. One of the significant findings of this study was that over 40 percent of the engineers in the Forest Service were less than 3 1/2 years out of college, and another 20 percent were considered to need new training. Findings of this study are now being used to improve the climate for engineers in the Forest Service as well as increase efficiency of engineering work.

In 1964, Mr. Dean retired as Chief Engineer, and he was replaced by Mr. J.J. Byrne, who had been heading up the Division of Forest Products and Engineering Research.

In 1965, partially as a result of the engineering study, an examination was made of the organization at the Washington Office Division of Engineering. The mission of the Division was defined, and a new organization was approved to carry it out. This study will be followed by additional studies of organization at various field levels—Regional Offices, Supervisors, etc.

As of this date, the Forest Service has over 1,000 engineers, geologists, and architects. These engineers cover practically all engineering specialties but are mainly Civil Engineers. At the present time, engineering-connected activities of the Forest Service involve an expenditure of about \$250 million annually. These activities will increase because the last Congress doubled the authorization for Forest roads and trails, increasing it from \$85 million to \$170 million.

The Early Early Days in Region 3

Howard B. Waha

As I contemplate in retrospect my early days in the Service, fate or destiny seemed to lead me into a number of interesting road developments. During my senior year at Penn State in 1909, five of our Civils chose, as a required thesis, the location, plans, and specifications for a 3-mile highway that, we learned later, were used by the State Highway Department in its construction. One week after graduation I was on my way to Albuquerque, entering the Service on June 30, along with Joe Kircher and Aldo Leopold, both having been graduated from Yale Forest School that same year. District 3 had only been established in 1908, with Arthur C. Ringland as its first District Forester. Boundary surveys, June 11th surveys with Jacob staff, compass, alidade, and 66-foot (100-link) chain, and miscellaneous engineering work kept me busy for the first year.

Roads

U.S. 66

In August of 1910, I was assigned to make a reconnaissance survey of the Coronado Trail in Arizona, so called because Francisco Vasquez de Coronado, the great Spanish explorer, was supposed to have traversed this route in his search for gold and the Seven Cities of Cibola in 1540. For the first several days, we worked out of Clifton, Arizona, looking over a few possible locations to get through the foothill country to the higher valley and mesa areas before hitting the high altitude White Mountain country to the north. Then Milt Rowley, Bill Brown (both Forest Guards at the time), and I started north with a pack outfit. Our first camp was in the vicinity of Grey's Peak, on a flat rocky knoll at a place called Mud Springs (consisting of an area about 15 feet square with water showing only in the cattle hoof-prints).

One morning we were suddenly popped out of our bedrolls by a piercing cry, up on the mountain slope. It sounded like a baby screaming in pain. Because of the ground cover, we couldn't see what it was, but it kept coming down the slope toward us and stopped at the water hole still screaming but not within view, although we sensed by this time it was a wildcat. We were plenty scared because we knew that something was wrong with it, and we also realized that we were without a gun! Bill Brown had loaned his 30-30 to a rancher on the Blue River the day before. Luck was with us, however, because there were many rocks about fist size and under on our knoll, so there was nothing else to do but throw them in the brush where there was movement. After a few minutes, which seemed like an hour, one of us scored a hit. We never knew who did it, but the cat started jumping up and down, screaming all the time, and then came limping out of the brush and across the water hole, dragging a broken hind leg, but it kept

coming right at us. Rowley had an axe by this time, and he silenced it with a blow on the head. Upon examination, we sensed that the animal had hydrophobia because its mouth and tongue were discolored and its stomach was empty, and the day after we hung the carcass on a tree limb, the hair began slipping, which was further evidence of the disease. Later we heard of several instances of hydrophobia in the area that year. A few days after this experience, we stopped at the Double Circle Ranch and learned that Mrs. Shannon had been chased by a mad fox. She had been gathering eggs at the barn, and in running toward the house, her sunbonnet had come off. Luckily, the fox stopped and chewed that.

One other event of note on this project is that while in our bedrolls under the stars at Honeymoon Ranger Station on upper Eagle Creek, we saw Halley's Comet streaking through the sky—a beautiful sight.

As I recall, the approximate distance of the proposed road within the Forest was 90 miles, and my estimate was \$150,000 to rough out an 8- or 9-foot road. How about that?

The Coronado Trail is now built, I understand, completed just recently. This highway is an excellent example of cooperative endeavor because so many Federal, State, and local governments took part in its construction down through the years: Bureau of Public Roads (BPR), State Highway Department, Forest Service, Greenlee County, WPA, and CCC. It traverses interesting country, and *Arizona Highways* magazine for February 1967 tells about it with beautiful color pictures.

U.S. 66 (New Mexico)

Being an "octogeneer" my memory is not as good as it used to be, but I think it was in 1913 during the early years of the 10-percent fund that we decided to work over some wagon tracks in Tijeras Canyon near Albuquerque, New Mexico. A few thousand dollars were made available for road improvements on the Manzano National Forest, so we hired about 100 Spanish-Americans, and with picks, shovels, horses, and slip scrapers, we started to work on the road which meandered up and down the streambed. Several fords were eliminated, and a few short bridges were built with concrete abutments. If you are traveling west approaching Albuquerque, you may catch a glimpse from your multilane U.S. Highway 66 of the remains of a concrete abutment far down in the canyon, a fitting monument to the first improved beginning of this most popular transcontinental highway through the gap between the Sandia and Manzano Mountains.

U.S. 66 (Arizona)

Since our Coconino Forest topped the list of gross receipts in the District, we had (what we thought in 1914) a real tidy sum to put into road improvement, and the most important road was a 29-mile east-west section between Flagstaff and Williams. This was part of a route called the "Ocean to Ocean Highway" and was the nemesis of many an early ambitious cross-country automobile traveler, because if not absolutely dry, the mud was a sticky nightmare. This was known as "malpais" volcanic formation and rightly named, because it means "bad country."

In scouting the areas within economic hauling distances, we found several volcanic ash locations, and some of them looked good for surfacing material,



Ocean-to-Ocean Road between Flagstaff and Williams, Arizona, 1914.

while others showed overburned cinders that we figured did not have the proper quality for mixing with the natural soil. At that time I had never heard of a P.I. (Plasticity Index), and I doubt if the term was in existence then. I may be wrong, but we were certainly lucky, because the material we got from the pits mixed beautifully with the malpais soil under traffic, to a consistency of an asphalt pad. We sprung the holes with a few sticks of dynamite, then poured in the black powder, which loosened the material sufficiently to load with teams and scrapers from a loading ramp to wagons underneath. The terrain was mostly flat through the pine timber, with very few hills, so there were no alignment problems except the location across a sunken area called Davenport Lake, which we crossed with a rock and earth fill, equalizing the water levels on either side by using large-diameter corrugated culvert sections. Naturally, we had to use a great number of these culverts for proper drainage, and as I recall, this carload of culverts was the first of its kind ever used in northern Arizona. When the State took this road into its system after several years, the alignment was changed and the road located around the north end of the lake; then later on when it became part of the Interstate System with BPR participation, the alignment was changed back to the causeway where I had located it originally.

Red River Road (Northern New Mexico)

During the summer of 1914, I took a survey crew to the high country on the Carson National Forest to locate a new road to replace an old road that actually was about 1 mile in length and dropped from an elevation of 10,000 feet to 9,000 feet into the Red River Valley. With all equipment and supplies, we were heading toward the valley in a freight wagon drawn by four horses, all brakes set and dragging a big log. We were on a 26-percent grade when the brakes gave way and the rear wheel horse stumbled, fell, and was dragged for about 30 feet. The downed horse served as a brake and saved us from almost certain disaster.

The survey was finally made on a fairly open but very steep western slope. The plans called for many sections of side hill cuts, which were practically through cuts, and several stations, mostly at the switchback locations, called for masonry retaining walls. We built the road by force account in 1915 and 1916. It had eight switchbacks and was something over 3 miles in length. The maximum grade was 7.5 percent. It is remarkable that this road has been traveled for over a period of 50 years. Shortly after its construction, a picture of it, with a short article, appeared in *Popular Mechanics*. Who did it or why, I never found out.

The May 1967 issue of *New Mexico* magazine has a double-page color picture of the new highway at the 10,000-foot pass. It also shows some of our old road, which brought back many memories.

Happenings & People

Fire Control

The things that stand out in my memory on this subject are the black metal, waterproof, telephone boxes at the lookout points. I cannot recall, in those early days of 1909 to 1915, a single lookout tower. I once walked up the Madera Canyon Trail and climbed a rock and timber ladder for 30 feet to the top of a peak in the Santa Rita Mountains south of Tucson. I carried a high-power telescope to see how far away I could detect a fire or smoke. I know I must have written a report, but what I remember most on that trip was the high wind and the cold temperature. I couldn't take any more than 20 minutes of it. It was in February, and we drove into Tucson in a freight wagon. The sun was shining, but a brisk breeze was blowing, and we had to take turns driving and walking to keep warm.

A breezy fellow, Starkweather, tall and handsome, came to the District from the Western Electric Company, with an innovation for more efficient fire control methods, which consisted of very small gauge-insulated wire to be strung along the ground for emergency telephone communication. A manual was written on this, but my memory goes back to a trip I took with Starkweather from Santa Fe to Albuquerque. He had either rented or borrowed a single-cylinder Brush automobile. We left Santa Fe at 10:00 on a cool sunny morning and arrived in Albuquerque, 60 miles away, the next morning at 2:00. The going was rough. We pushed the car across many sandy arroyos, using the rubber floor mat and anything else we could find that could offer better traction than loose sand. The ignition system went haywire, so with flashlight, paper, and pencil, we traced the entire wiring system until we found the trouble. We really had our fill of sand and dust. It was anything but a joy ride!

Border Incidents

Because of an outbreak of a cattle disease along the border between Mexico and Arizona, the Bureau of Animal Industry decided to build a fence along the border to keep Mexican cattle from crossing into the United States. The Bureau asked the Forest Service to assist by furnishing a survey crew, and I was assigned to the job.

The survey notes indicated a number of monuments along the line, supposedly visible, each from the other, distances depending on the terrain.

Our job was to stake out an offset line, 100 feet (I think it was) north of the boundary, on which the fence would be built. The strip (200 feet wide) was the "no man's land" between the two countries.

We started the survey at the corner common to New Mexico, Arizona, and Mexico, and headed west. The going was rough. I practically wore out a pair of hobnailed boots in 2 weeks. We had difficulty in finding some monuments, but eventually completed the survey of about 20 miles.

At the beginning of the survey, I stayed one night at the Diamond-Bar cattle range headquarters. It was the day the foreman came back from Hachita, New Mexico, after having been exonerated from killing a man the day before at the headquarters. The facts were simply that the foreman had recently been appointed, and another hand thought he should have had the job and was drinking and threatening to get the foreman. The foreman had been told about it and had a gun at the back door of the cabin. When the fellow approached the cabin from the corral, Parks, the foreman, opened the door. The man pulled his gun, but was not quick enough, and Parks let him have it at close range. Just as simple as that.

What I am leading up to is that I slept in the same room that night with the killer—in fact, in the same double bunk. He really did some tossing and turning and mumbling through the night, but he was a good man and his conscience was giving him a hard time.

We made this survey a couple of years prior to Villa's Raid in 1916. There had been occasional incidents, and patrols from the Third Cavalry at Fort Huachuca, Arizona, were stationed along the border. These troopers were a sinister-looking outfit on black horses. One day a couple of us were in a swale when suddenly we heard the whine of bullets just over our heads. There was no time to be scared. We stooped and ran out of there and around a small rocky hill and saw a group of troopers at target practice. They, of course, didn't know we were in the vicinity and apologized. We were grateful that we were alive.

People

John Beebe and I had a room together in the Adams Hotel in Phoenix. John lived up to his reputation as a power engineer, in my estimation, when he opened his suitcase and pulled out a cord 20 feet long—the longest transmission line for an electric razor that I ever saw! If he wanted to shave in bed while reading, he was all prepared.

It was in the spring of 1911 when I first met Ted Norcross in Denver. I had been assigned to cooperative work with the USGS in streamflow measurements in Colorado and Wyoming. There was a growing conflict at the time between power companies and the Government, and in order to determine whether lands were more suitable for power sites than for agricultural purposes, the need for more water supply or streamflow data was necessary to make proper decisions.

That summer Ted and I made a trip to Arkansas on a small power case on the Ouachita National Forest. I was to make a plane table topographic survey of the area, and then we were to meet before a judge in Fort Smith. We arrived in Kansas City by train at dusk—temperature over 100 degrees

with high humidity—and had to stay overnight at a hotel. It was too hot and muggy to sleep, so Ted and I took turns trying to cool off in the bathtub all through the night. I lost 10 pounds on that field trip, came close to a sunstroke working on that white paper, and too dumb, as I look back, to think of dark glasses—and now I'm wondering if dark glasses were used to any extent in those days.

My memory fails me with regard to the outcome of the hearing, but I remember that the judge intimated that Ted was not telling the truth when he told the judge that the Arkansas River had its headwaters in Colorado. My field trips with Ted were always enjoyable. He was a grand person.

In 1911, the population of Phoenix, Arizona, was about 20,000. I'll never forget the trip I took from there to the Roosevelt Dam, 60 miles away, on a stagecoach with four horses, changing teams about every 12 miles. It was a thrilling ride, particularly in the mountainous area, and down the famous Fish Creek Hill. The Tonto Forest had its summer headquarters at the Dam and because electricity was available, without charge, the hot water tank (about 120-gallon capacity) was uniquely heated by completely surrounding it with innumerable light bulbs.

It was here that sometime before my visit, Jack Barber, a young fine-looking (but mischievous) ranger, did something way beyond the call of duty. Will C. Barnes was one of the pioneers in the Service—a famous author and former stockman and one who did more than any other individual toward lessening the animosity that stockmen felt toward the Service in those early days. As Chief of Grazing in Washington, he was on the Tonto on an inspection trip. One cool night while the group were in their bedrolls under the stars, Jack let the air out of Barnes' mattress. Will awoke very uncomfortable, after awhile, on the cold hard ground. I don't recall he ever learned that he was the victim of an intentional prank.

From Roosevelt Dam, after a Thanksgiving Day of duck hunting, I rode horseback up to Pleasant Valley to try to solve a water supply system problem at the ranger station. Pleasant Valley and the area under the Mogollin Rim was the locale of many of Zane Grey's novels.

When I came back to Region 3 in 1937 as Regional Engineer, the changes I saw after an interval of 22 years were amazing—and more so during the forties. In 1914, for instance, I led a party on a preliminary survey in the Jemez Mountains of New Mexico. I rode horseback through the site of the present city of Los Alamos. There was one log cabin in the entire area.

The transportation development through the years has been one of great importance, and I feel that the splendid cooperation between the Bureau of Public Roads, the State Highway Departments, and the Forest Service has been outstanding from my viewpoint. It was always a pleasure to meet with these representatives on our Forest Highway Programs, and it gave one a sense of pride, not so much as an individual, but more as a member of a sincere, dedicated group. Yet, one has a feeling, too, that he played a small part in the development of the West. And it's a good feeling!

Theodore W. Norcross (1883–1965)

Theodore W. Norcross, the son of John Henry and Cynthia Josephine (White) Norcross, was born in Medford, Massachusetts, on January 25, 1883. He was graduated from Tufts College with a bachelor of science in civil engineering in 1904.

Mr. Norcross entered Government service in September 1904, and was engaged in stream measurement, lake and river surveys, and other hydrographic work for the U.S. Geological Survey until early in 1907. From then until the fall of 1909, he was employed by the City of Springfield, Massachusetts, in charge of the engineering office and later as resident engineer in the design and construction of a large water supply and filtration system. He returned to the Geological Survey as district engineer and was located first in New England and later in California. In the fall of 1910, he was transferred to the Forest Service, served as District Engineer for the Rocky Mountain and Southwestern Districts, and was engaged primarily in investigations and reports on water power, irrigation, and water supply.

In 1913, Mr. Norcross became Assistant Chief Engineer of the Forest Service with headquarters in Washington, D.C., and in 1920 he was made Chief Engineer. As head of the Engineering Division, he was in charge of all engineering, construction, and maintenance work on the National Forests and for the Forest Service. Such work included road and trail planning, construction, and maintenance; architectural and structural design of administration and protection improvements; water power; water resources; erosion and flood control; hydraulic structures and investigations; utilities; sanitation and drainage; surveys, mapping, drafting, and photography; and technical advice and services. He handled cooperative work of the Forest Service on engineering matters with the Public Roads Administration, Federal Power Commission, U.S. Geological Survey, National Park Service, and other Federal and State agencies.

Mr. Norcross retired from the Forest Service on December 31, 1947. In view of his long and distinguished Government career and his outstanding contributions to the Forest Service and the Department of Agriculture in the field of engineering, he was named as a collaborator of the USDA by the Secretary.

After retirement from the Forest Service, he became secretary-treasurer of the American Society of Photogrammetry and served as the editor and business manager of its journal *Photogrammetric Engineering*. For his contribution to the work of the Society, he was made an honorary member.

Mr. Norcross was a member of the American Society of Civil Engineers, the American Society of Photogrammetry, American Congress on Surveying and Mapping, and an associate member of the Society of American Foresters. He died in Washington, D.C., on March 24, 1965.

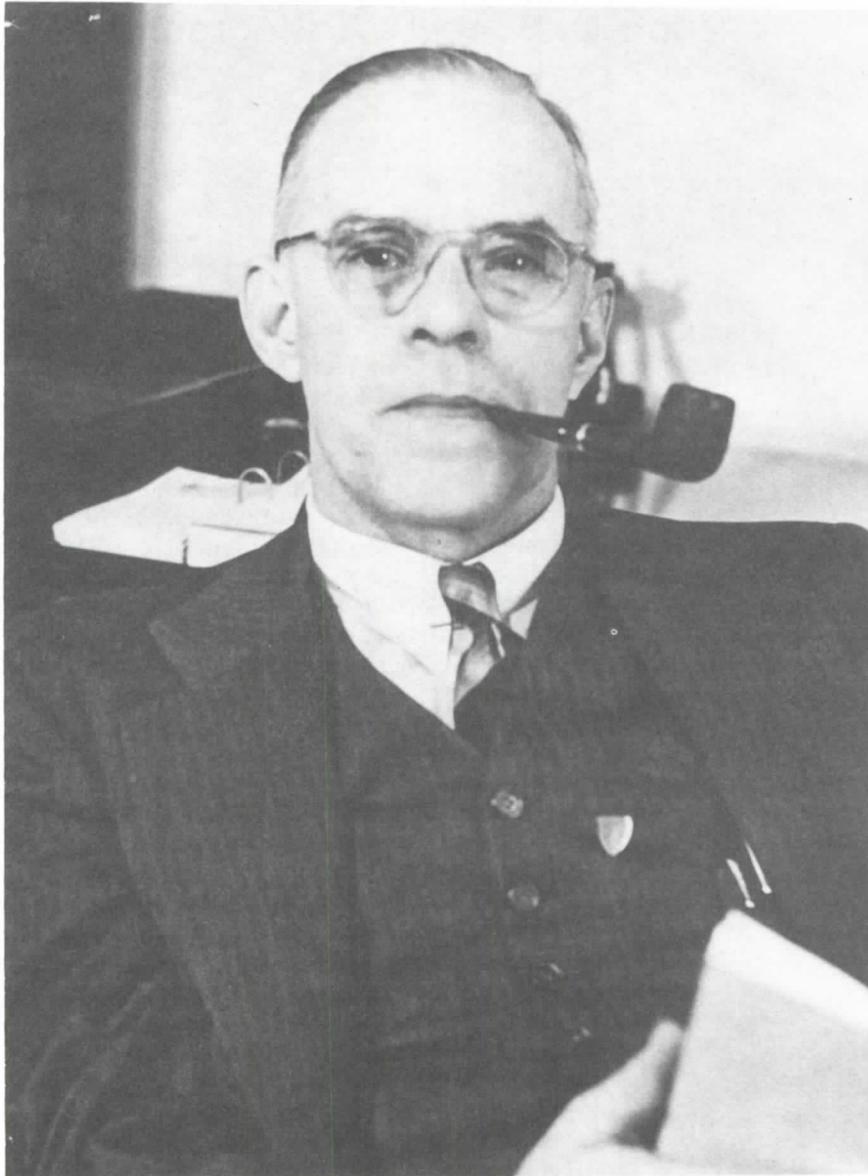


Theodore W. Norcross.

John C. Beebe: A Biographical Sketch

B.S. 1909; C.E., University of Wisconsin, 1910; Junior Engineer, Water Resources Branch, U.S. Geological Survey, Helena, Montana, 1910-11; Junior Engineer, U.S. Forest Service, 1911, 1912; in charge, Prospect Creek Development, Thompson Falls, Montana, for Montana Power Companies, 1912; with J.S. Keerl, Helena, Montana, 1913; in charge, W.T. Smith's irrigation project, Prussia, Saskatchewan, 1913; Power and Pumping Engineer, Idaho Irrigation Company, Richfield, Idaho, 1914-15; Assistant Engineer, Miami Conservancy District, Dayton, Ohio, 1915-16; Construction Foreman, U.S. Reclamation Service, Deaver, Wyoming, 1917-21; Construction Superintendent, Wyoming Highway Department, 1921-22; Engineer and Manager, Glen Lake Irrigation District, Eureka, Montana, 1922-25; Designing Engineer with Fred H. Tibbetts, San Francisco, California, 1926-27; with U.S. War Department studying debris conditions for California Debris Commission, 1927-28; Assistant Engineer, Pacific Gas & Electric Company, 1928-29; Senior Civil Engineer, U.S. Forest Service, 1929-36; Regional Engineer, U.S. Forest Service, San Francisco, California, 1936-39; Chief, Division Power-Flood Control Surveys, Federal Power Commission (FPC), Washington, D.C., 1939-41; Chief, Bureau of Water Power, FPC, Washington, D.C., 1941-44; Regional Administrator, FPC, San Francisco, 1942-45; Special Assistant to FPC, Washington, D.C., 1945-48.

Retired 1948. Member: Cosmos Club (Washington); ASCE; Commonwealth Club (San Francisco). Route 1, Rathdrum, Idaho.



John C. Beebe.

Division of Engineering: Historical Incidents (June 1912–December 1950)

Fred E. Thieme

The writer, Fred E. Thieme, after graduating from the University of Montana at Missoula in June 1912, with a B.A. in civil engineering, entered the Regional Office of the Forest Service under an appointment as Surveyor, \$1,200 per annum. Two years later, the Engineering School was moved from the University to Montana State College at Bozeman.

The Regional Office was then located in the Hammond Building at the southwest corner of Higgins Avenue and West Front Street where the Missoula Drugstore is now located. Other graduate engineers in the Engineering Division were E.W. Kramer, G.H. Lautz, and Charles Farmer. Frank E. Bonner was District Engineer; Kramer was in charge of water power; Lautz was assistant to Bonner; and Farmer was a draftsman. I was immediately assigned to the field and did not get to know the other office personnel. Greeley was the Regional Forester.

My first assignment was making a plane table topographic map of an area between the Bull River and Clarks Fork on the Cabinet Forest. Farmer was in charge of a second party. Progress was slow on this survey, because of the inexperience of the chiefs of the party.

From there, I was transferred to the Kaniksu Supervisor's summer office in Coolin, Idaho, at the foot of Priest Lake. There I compiled timber reconnaissance survey field strips into a composite map, and in the fall, I was assisted by Mr. Mangum, a soil scientist on detail from the Bureau of Soil, in making a soil survey of the Priest River Flats to determine what might be agricultural land subject to be June 11th homesteads. The winter was spent in compiling a soil map from our field data.

The winding road through the timber from Priest River to Coolin was a trail widened into a low standard road. Beardsmore operated the stage and in the spring of 1913 changed from horses to an automobile and had considerable difficulty getting over the road.

In early June, the Forest was given an allotment of \$2,000 of 10-percent funds. This was the first allocation of these road funds. At the same time, the Bitterroot-Big Hole Road was started. The Forest Service wanted to use the \$2,000 mostly cutting out the steep grades in and out of Big Creek, a 1-mile section of the 22 miles of road between Coolin and Priest River. Beardsmore and other users wanted the \$2,000 spent in improving the entire 22 miles.

I made a location survey across Big Creek but left before construction was started. I was transferred to the Regional Office about July 1, 1913, to take charge of a homestead entry survey (H.E.S.) party. The Regional Office had been moved from the Hammond Building to the second and third floors of the new Post Office Building. The following 3 years were spent in making these surveys. From then until I retired on December 31, 1950, I was in the Regional Office in various capacities.

In December 1914, I married Ella Clair Hopkins in Wickliffe, Kentucky. The next spring she accompanied me into the field as cook and a member of the party at \$40 per month. I was then getting \$1,400 per annum. Between the two of us, we thought we were making big money. We were making surveys in the upper Yaak River Valley. The homesteads were covered with lodgepole timber with a thin gravelly soil for the most part. The homesteaders were having a hard time of it. While camped at the Upper Ford, some person or persons were entering my cook tent at night and making off with grub. At first, only small amounts were taken and then considerable amounts. The cook was perturbed because her meal costs were going up. I fixed up a burglar alarm by using emergency telephone wire strung across the tent opening and attached to dishpans. A few nights later, I responded to the alarm and saw a light going down the trail. On the command to halt, the light was ducked and the person turned off into the woods. I returned to the sleeping tent without having fired a shot. A couple of nights later, another alarm—the culprit this time was a wild bobcat. I shot the animal and on returning to the sleeping tent, my wife was scared stiff and at the “ready” with her shotgun. When asked why she was so scared, she replied, “I didn’t know who shot first.”

In December of 1920, O.C. Merrill, then Chief of Engineering in Washington, D.C., went to the Federal Power Commission. Frank Bonner was transferred to Washington to fill the position vacated by Merrill. George Lautz took Bonner’s place as District Engineer in Region 1. I functioned as principal assistant to Lautz with part-time field work. R.H. Rutledge was then Regional Forester succeeding Silcox.

At a meeting of Regional Foresters, Forest District Engineers, and Bureau of Public Roads (BPR) District Engineers in 1918, it was proposed that I transfer to BPR to take charge of BPR work in Alaska. Regional Forester Rutledge, whom I consulted with about the proposed transfer, advised me to stay in Region 1.

The Section 8 Forest Road Act was in effect prior to the Federal Highway Act of 1918. The Section 8 funds were for building public roads on and adjacent to the National Forests. Cooperation by the counties was not required but encouraged. These funds were in demand, and considerable time was spent in negotiating cooperative road building agreements with the various counties. BPR handled the construction work. Prior to the Section 8 Act, the only road funds were from the 10-percent fund.

For years after the passage of the Federal Highway Act, under which Federal Road Development (FRD) funds were appropriated, a large part of these funds in Region 1 were used to build trails into inaccessible areas, largely in the backcountry, in line with a Washington Office policy pronounced by Roy Headly. Although access to back areas was needed, the principal

thought behind building trails was that these construction crews would be available for controlling forest fires and were extensively used for that purpose even to the extent of subsidizing firefighting from FRD funds. The allocation of funds and supervision of trail construction was done by the Division of Operation without much participation by the Division of Engineering. The construction of buildings was also an Operation function. Both were later transferred to Engineering.

Fred Morrell succeeded Rutledge as Regional Forester, and although he favored a policy of building more roads as a means of providing faster firefighting response and a means of hauling logs to the market, the Headly policy prevented him from doing so until shortly before he left Region 1. Timber sales of those days were relatively small, as the private timber holdings were supplying the bulk of the market requirements. With but few exceptions, logging roads were of low standard aimed at serving the present small scale and would be of little or no value for the removal of logs from the next sale. Headly, Chief of Fire Control in the Washington Office, was an advocate of low-standard, low-cost roads aimed at providing fire control but useless for logging. Timber areas were avoided wherever possible in order to reduce construction cost. Narrow, 8-foot widths and steep grades were the rule. Major Kelley, inspector under Headly, was of like mind and continued that policy when he succeeded Fred Morrell as Regional Forester.

I advocated building FRD roads with moderate grades and sufficient width to permit drainage and surfacing where the soil was unstable to permit a longer logging season. Such roads would be a relatively expensive charge against the first sale, but would increase the stumpage value of the succeeding sales. Fred Morrell saw the wisdom of better roads both for the increased speed of transportation for fire control and reduced logging costs, but told me he could not issue instructions to that effect with Headly and Kelley opposed to it. I took it as a tacit understanding to build some higher standard roads, which appeared to be good economics, but in doing so, I was on my own. When Headly caught up with me, Morrell had to read me the riot act in his presence. Under the conditions, it was not too hard to take.

In addition to providing FRD funds, the Federal Highway Act was to provide Forest highway funds for the construction of public roads on and adjacent to the National Forests. Rivalry was keen between communities for these funds. Red Lodge, Montana, was pushing for a road between that town and Cooke City, an old mining camp, at the northeast corner of Yellowstone National Park. A Doctor Seifert(?) for years was the chief booster and spokesman for Red Lodge. Since there were ten places for every Forest highway dollar for improving existing inadequate Forest highways, the State Highway Department, BPR, and the Forest Service were all opposed to its construction until other more important highways were first built.

In 1924, O.H.P. Shelly, a former State Chairman of the Republican Party and a man of considerable political influence, became a resident of Red Lodge and its chief spokesman. They presented a glowing picture of reviving the Cooke City mining camp, making coke from Red Lodge coal and using it for smelting ore at Cooke City. They put the heat on the Forest Service and Regional Forester Morrell, resulting in a promise to make a

reconnaissance survey of the route by the Forest Service and BPR to determine its feasibility and cost.

B.F. Kitt, Highway Engineer for BPR, and myself were assigned to this task. We made a reconnaissance in June of that year and made certain other investigations relative to it. We found that the coal from Red Lodge was not capable of being coked. A sample batch had at one time been sent to a coking plant in which it fluxed and ran out of the furnace as a viscous liquid. I also made an investigation of the mining possibilities in the Cooke City district, getting expert information from one of the large mining companies in Montana.

In preparing our preliminary report, I stated that it was my opinion that the mining possibilities of Cooke City were of small value and that the whole idea of building the Cooke City road for mining purposes was absurd. I was advised by Regional Forester Fred Morrell to eliminate from the report my deduction regarding the mining aspects of the Cooke City district as I was not a mining engineer; and therefore, the report would be subject to attack by the proponents of the project. Later, our mineral examiner examined the district, using much of the information that I had secured, and made a supplemental report.

The three agencies, State, BPR, and Forest Service, were still in the same position relative to making it a Forest highway. In my report, I had stated that if and when the State could afford a road such as this it would be unique in character as a park entrance. It would travel high country, going over the Beartooth Plateau at an elevation of over 10,000 feet, while other roads into Yellowstone Park followed river routes for the most part. But as a mining road, it had no merit.

One interesting event while making the reconnaissance occurred. The packer who was doing packing for the party was acting as an agent for O.H.P. Shelley, and when Kitt and I discussed the merits of the project in his presence, it reached the ears of Shelley in short order. Since, apparently, we had expressed ourselves as finding no merit in the project as a mining road, Mr. Shelley rode out to the job and told Kitt and myself how influential he was in Montana and how many people he had assisted in getting jobs and assisted in getting fired. He advised us that if we liked our jobs we had better make a favorable report. We told him that we didn't like our jobs and that if someone would fire us it would probably be to our benefit and proceeded to make our report in light of our findings. After the report was out and the Red Lodge people had a chance to read it, they asked Fred Morrell to come down with Kitt and myself to meet with them. Morrell had heard that they were going to try to go after the two of us for making such a report and thought it advisable that neither one of us attend the meeting. Afterward, I asked him how he got along; he said, "I was able to get along, but I think if you or Kitt had been there, there would have been a hanging party."

Through the influence of O.H.P. Shelley and the help of Congressman Scott Leavitt, a special appropriation bill was passed that was general in nature, but under the provisions of which this route and one other were the only ones that could qualify. The reason for making the bill general in character apparently was to keep away from making a special appropriation for any

one specific job that, it was felt, would undercut the principle of general Federal and Forest highway appropriations. Except for about a 5-mile section built as a Forest highway, it was built from this special appropriation.

At the beginning of the great depression of the early 1930's, Morrell went to the Washington Office and Kelley became Regional Forester. One of the first policy changes he made, was to cut down on the building of trails in favor of building low-class, low-cost fire control roads on a grand scale, at the cheapest possible cost. With the invention of the bulldozer, roads were built cheaper than hand-built trails. It was not until the Civilian Conservation Corps (CCC) program came into being that the engineers were permitted to use higher standards.

The CCC camps occupied in winter were those in the low country on main drainages. Winter work was largely limited to road building along these drainages where more rock was encountered than along the ridge tops or at intermediate elevations. We were able to build some fairly suitable roads. This was not to say that many miles of low standard roads did not serve a great need for fire control and suppression. It is true that the pioneers got along with primitive roads, but their means of transportation were primitive. We were still following the primitive thinking. The Supervisors were instructed and it was their duty to change any engineer's survey if by doing so the cost of a road could be reduced. Since this would have led to an absurd situation, there were not too many instances where this was done.

After a heated talk with Major Kelley, at which I wanted to discontinue building such steep grades, he organized a demonstration to show how an old mining road near Haugan, Montana, with 23-percent grades and sharp switchbacks could be used for trucking mules. Those required to witness the demonstration were the Chief of the Experiment Station, Chief of Operation, myself, and others. Shifting gears on the steep pitches caused the mules to get down. Considerable time was required to get them back on their feet. Finally, the 6 1/2 miles were made in 3 1/2 hours. Kelley declared the demonstration a success and seemed to be quite pleased until the Chief of the Experiment Station said, "Yes, you made it in 3 1/2 hours, but how much slower should the travel time be over a road than walking the mules over a trail?" After that demonstration, engineers had less trouble laying out roads with more moderate grades.

About the time Major Kelley retired in 1944, the use and sale of National Forest timber were in greater demand as private timber holdings were being cut out.

To assist administrators and engineers with criteria to apply to the problem of log transportation, I had Roger Nelson, an engineer in the Division of Engineering, later Regional Engineer at Albuquerque, make a log-hauling study. It brought out that all truck cost items except tires were functions of time. Faster transportation means cheaper hauling costs. The volume of timber determined what could economically be expended in building a road to accomplish the cheapest transportation. Nelson did a good job on that study. It led to a more thoughtful approach to road building.

Under Pete Hanson, who succeeded Major Kelley, and the growing demand for National Forest timber, the value of engineering services was being recognized. Engineers were no longer on the defensive and frustrated. From then until I retired December 31, 1950, engineering work in Region 1 was a challenge, a pleasant and rewarding experience. The pioneer stage was passing.

It is interesting to look back at the time changes in construction methods. Until about 1918, Forest roads were constructed with pick and shovel whether by our force account jobs or by contractors. Rock was drilled by hand. There were no portable air compressors. The volume of material and width made a steam shovel impractical. About 1928, I wrote one of the large manufacturers of compressors (stationary type) that we needed portable compressors for road and trail work. They said they would be glad to make such a machine if the Forest Service would pay for the development costs. The Fiscal Agent said we would not enter into such a contract.

The St. Joe National Forest was starting to build a trail up the St. Joe River above Avery, Idaho. It involved much rock work. I had the Spokane shop assemble a small horizontal stationary compressor driven by a White truck motor installed in a boat. Air for a single jackhammer was piped to the trail above the river. It was a makeshift outfit and took a machinist to run it. It operated as long as the machinist was on the job. The foreman objected to paying him \$1.25 per hour and let him go. A mule packer was given his job. The machine did not operate long. It broke loose and went down the river.

Later, Al Rickel of the Spokane shop made a compressor out of a four-cylinder automobile engine, two cylinders used as a gas engine and two as compressors. It was mounted on small tracks with a narrow tread for trail work. It did good work. A compressor company became interested and wanted the plans. There were no plans so the machine was sent to the factory and copied, with improvements. About that time, trail work was abandoned in favor of road work. It led to the building of portable compressors for road work.

From about 1920 to 1927, roads were constructed by first building a horse trail with pick and shovel, followed by a heavy draft horse pulling a two-way plow. This was widened by a horse-drawn Martin ditcher, which provided width for a small tractor (Best and Holt, later to become Caterpillar) pulling a small grader. After repeated passes, a roadbed was constructed.

While on a field trip with Regional Forester Fred Morrell about 1926, I mentioned that a large two-way plow mounted in front of a tractor might eliminate the hand-built trail and Martin ditcher. He said, "Why don't you build one?" At that time, we had no shop facilities, and it never occurred to me that the Forest Service might get a commercial outfit to develop it. Later, while accompanying an engineer from Region 6 around Region 1, I mentioned my plow idea. Region 6 had good shop facilities transferred to them by the Navy. He said they would take on the job if Region 1 would help finance it, which we did. During the rest of the trip, we batted the idea around, arriving at the conclusion that a reversible angular blade might build the entire road except for finishing with a grader.

About 1930, Region 6 developed such a machine. I think it was manufactured by a commercial concern. We took seven of them. When in working order, these machines revolutionized our type of road construction. But they were continually breaking down and in working order only about one-third of the time. We all realized the need for a sturdier machine.

When we learned that no major changes were to be made in the machines to be built for the following season, Major Kelley asked if there was something I could do about it. I said I had made a sketch of a simpler machine that could be developed by a commercial outfit with a mechanical engineering department. This was just before Christmas. On January 2, I started looking. After making several calls, the Isaacson Iron Works Company of Seattle was contacted. The great depression was on, and the Company was in financial difficulties due to lack of business. John Isaacson was a fine, honest, and considerate gentleman. Using my sketch as a starting point, his mechanical engineer and I batted the thing around for a week before he would consider taking the job. Time was of the essence as the machines had to be in production by the next working season or Region 1 would be in the dog house and the Regional Engineer the dog. Region 1 ordered no more of the Region 6 machines.

Isaacson was not able to finance the full development. After phoning Major Kelley, I entered into a contract with Isaacson to design and manufacture a working model for \$2,499, the maximum amount permitted without calling for bids. The Forest Service reserved the right to manufacture them for its own use if patented.

The working model was field tested in March. Some bugs showed up. Isaacson got the manufacturing bid. During the development stage, Mr. Isaacson asked if I thought contractors would use the dozer to any extent. I told him I did not think so. What a prophet I was!

The blade was mounted on a 35 Cletrac tractor, the frame of which was not sturdy enough to support the dozer. Changes had to be made later. Isaacson developed the business, which he told me later put him back on his financial feet.

The Region 1 model was better than the Region 6 model, and later models were better than Region 1's. I have gone into such detail about the dozer because the Forest Service did a lot to develop and stimulate road building equipment. Region 6 built the first power lift grader because grader manufacturers thought the hand lift was good enough. After viewing a power lift grader demonstration, the grader manufacturer got busy.

George Duncan of Region 1 got Isaacson to build a self-cleaning roofer.

Map making was always an important engineering activity. In the early days of the Forest Service, maps of large areas of the National Forests were compiled from crude reconnaissance data and were unsatisfactory for Forest administration. Ground survey methods were so expensive as to be out of financial reach of the Forest Service or the U.S. Geological Survey. Jim Yule, Chief, Surveys and Maps Section, was enthusiastic about the then developing theory of producing maps from aerial photographs and the special equipment required. Since it appeared that this method would be so much

cheaper than ground methods, it was evident that with a limited budget, it was the answer to our map making.

No regular map making funds were available even for an experimental project. Howard Flint was then trying to develop aerial fire control. The Forest Service had a contract with the Johnson Flying Service for flying time. Flint, who was an observer on fire patrol, was handicapped for lack of adequate maps. Yule got him interested in aerial mapping. Flint bought film and a camera from his fire control budget. On his patrol flights as observer, he took photographs of large areas that were compiled into maps showing drainage and ridges. At first, the methods of compilation were rather crude, but produced maps giving far better service than anything we had previously. From that humble beginning, the art of aerial mapping with modern equipment has advanced remarkably.

There was but little increase in Engineering personnel until the beginning of the 1929 depression period. One of the early means of combating unemployment was the NIRA appropriation (I do not recall the wording for these initials). Under this program, road construction, bridge building, and building construction were greatly increased, requiring the services of an enlarged engineering and construction force. All work was done by day labor under supervision of Forest Service personnel. Under this program, we had to take on some men appointed by Congressmen and representatives (political appointees). Too many of these were not qualified for the work. The Civilian Conservation Corps Act of 1933 superseded those previous programs. It in turn was liquidated in 1943.

An interesting experience of CCC work was the requirement that we give employment to six engineers appointed by Murray, who at that time, was Congressman from Butte. We were quite unhappy over the prospects of not getting qualified engineers because of our previous experience with political appointees. When asked by one of my assistants what he should do with them, I told him to assign them to regular engineering jobs and, if found to be unqualified, to put them to doing something that would not result in harm. Everyone assumed they would not be qualified. Some time later, one of these fellows working on some project along with his immediate supervisor came into my office for consultation regarding some problems. I noticed this fellow seemed to be a knowledgeable and qualified engineer. After the meeting, I asked his supervisor who he was and where he had come from. He told me he was one of the political appointees from Butte and was a good engineer. He was Jim J. Byrne. His record showed he had a master's degree in electrical engineering from M.I.T. He came to us with but little practical experience except for a hitch in the General Electric Research Laboratory. I pushed him along, giving him what help and assistance I could. He became a valuable and trustworthy man in the organization. At this writing, June 1967, he is Director, Division of Engineering, in the Washington Office.

An interesting episode concerning Byrne. Major Kelley called me into his office and said, "I have been going over your Engineering personnel, and I don't think you should keep your man Jim Byrne. He does not look strong. Forest Service personnel should be husky and strong." I told him he was one of the most knowledgeable men in the Engineering Division and I could

not fire him unless he have me specific orders to do so. It was left hanging in the air.

Later, Jim joined a discussion group of professors of the University of Montana at Missoula. One of the group told me that Jim added much interest to the meetings. Major Kelley and his wife often had groups of these professors as dinner guests.

Later, Kelley called me in and said, "What are your plans for that man Byrne?" I told him I wanted to make him assistant Regional Engineer. He said, "Why don't you do that and the sooner the better." I was puzzled over the change in attitude. It was not until one of the professors who had been to one of Kelley's dinner parties told me that in talking shop he had told Kelley that if the Forest Service had need for men with brains, they should keep Jim Byrne. Before I could promote Jim to assistant Regional Engineer, Kelley was transferred to the Guayule Rubber job. Jim was one of the first men he called for and made him one of his chief assistants.

During the early CCC days, our bridge building was limited to small structures, except for a concrete arch crossing the Gallatin River designed by Jim Byrne. We needed a full-time bridge engineer as Byrne was being used in other work. The Idaho State Highway offered to loan me one of their bridge engineers, providing I could talk him into working with the Forest Service. The loan was to be for a period of 6 months until the work could be organized or another bridge engineer obtained in case he wanted to return or the Idaho Department would recall him. I talked with Art L. Kahl, who agreed to come. Later, they asked for his return; but I talked them into letting him stay. He stayed until his retirement.

Art Kahl was an excellent bridge engineer. He designed and supervised the construction of some major steel bridges for crossings of some of our large rivers. He organized several traveling bridge construction crews. Some of the longest spans were erected by CCC crews working under the supervision of a bridge foreman and a small contingent of specialists.

At the time, it was the requirement that inspection memorandums be much in detail. The longer the report the better, it seemed. Art was a busy man for he had only one or two assistants in his office and had to do all major designing and inspect field construction. He never made a written inspection report, and I never required him to do so. I knew more about his bridge jobs from his brief verbal reports than some other engineering activities.

C.E. Remington came to us during a winter layoff period from the Idaho State Highway Department. He proved to be a good organizer. After several years with us, Idaho's Chief Construction Engineer called at the office looking for a young engineer by the name of Remington who had worked in his department several years before as resident engineer on a number of asphalt oil road mixed jobs. He told me his department had just completed a study of all oil jobs in the State and found that the several jobs done by this Remington were holding up better than any of the others. He recalled that this engineer was not using as much oil in the mix as was specified. He was furloughed at the end of oiling season before an inspection of his work could be made. He said they had lost the best oiling engineer they ever had and did not know it. Remington later became Chief,

Division of Engineering, of the Bureau of Land Management in Washington, D.C.

Roger Nelson was another of those engineers that I felt I helped train. This training job is a two-way street. A good engineer also helps train the boss.

At times, the fiscal personnel interpreted the regulations such that we could not accomplish the work we had to do with funds appropriated for the purpose. In such an event (there were several), we would proceed to get the work done and I would assume the responsibility. This was a dangerous doctrine and got me into temporary difficulties a number of times. "The turtle never goes forward without sticking his neck out." I also had a rule that should any man be dishonest by diverting Federal funds for his own use or other than for the best interest of the Government, he need not come to me with anything except his resignation.

I think I had a loyal bunch of people in the Engineering Division and deeply appreciated it. Whenever a fellow was doing a good job and was unjustly criticized because of a lack of knowledge or misunderstanding, I backed him up to the limit of my ability.

Region 1—A Letter to Major Kelly

Hartley A. Calkins

HARTLEY A. CALKINS
In Charge of Road Work
Engineering, R.O.
(Retired 1943)

Missoula, Montana
March 1944

Dear Major Kelly:

I am glad to comply with the request in your letter of December 29, 1943. I have been somewhat laggard in doing so, but the time has been utilized in thinking about how I might relate my experience that it would best serve the purpose intended. Frankly, I doubt that more than a very little if any of what I have to relate will serve your purpose; however, that is for you to judge.

I think I would like to give my impression of the Service as gained in those first years.

Before coming to the Forest Service I had worked at various jobs in many places, from Minnesota to Oklahoma. This included common labor for small firms and individuals, engineering work for five different railroads, and with the Bitterroot Valley Irrigation Company. In all this time I had always been treated fairly and with consideration; however, the moment I joined the Service I sensed a different attitude. The men I came in contact with were more friendly and seemed to take personal interest in me as an individual. That was something new.

I was not educated or trained as a forester; to me this was only a job. For this reason I have felt that my observations might have special significance.

I entered the Service January 1, 1914. In the late fall of 1914, I was sent to Priest River. While going over I was riding in a double Pullman seat and in the opposite seat I had placed my briefcase. It was one of the old canvas cases with "Forest Service" stamped across the front. A man came along, saw this, and asked me if I was with the Service. I told him I was. He sat down with me, introduced himself, and we visited. During the time he sat there he told me all about the Forest Service, what it stood for and its objectives, all about what they were striving to accomplish. The man was Colonel Greeley, and the incident made a lasting impression on me. I could relate other incidents involving Mr. Silcox, Frank Bonner, and others along the same line, all of which convinced me that I was identified with an

organization whose leaders were interested in something besides feathering their own needs.

By 1915 the Engineering Division had somewhat expanded and consisted of a number engaged in entry surveys, maps, and surveys. Road development was just starting. The organization at the time was, as I recall it, about as follows:

Frank Bonner, Chief of Geography
E.W. Kramer (deceased), District Engineer, Water Power
George Lautz, in charge of Entry Surveys
Ray Maurer (deceased), Entry Surveys
Elmer Johnson, Entry Surveys (now in Region 6)
Fred Thieme, Entry Surveys
C.W. Cheatham (deceased), Road Engineer
Robert Gumaer (deceased), Road Engineer
A.V. (Shorty) Williamson, Road Engineer (now with PRA at Denver)
H.A. Calkins, Road Engineer

Maps & Surveys & Drafting

J.B. Yule
Frank J. Cool
Chas. Farmer (now in private business)
Jean Ewen (PRA, Portland)
George Stadler
Joshua Cope
Joe Halm
C.H. Fisher (deceased)
William Nagel
John Taylor
K.D. Swan
Clarence Beaman

Don Sawhill and W.P. Stephenson were assistants on Entry Surveys.

The female contingent consisted of Miss Lambreat and Mrs. Chas. Vealey.

The District Office heads were as follows:

F.A. Silcox, District Forester
R.H. Rutledge, Assistant District Forester, Lands
C.H. Adams, Assistant District Forester, Grazing
D.T. Mason, Assistant District Forester, Silviculture
D.F. McGowan, Assistant to the Solicitor
J.A. Urbanowicz, District Fiscal Agent
John R. Preston, Assistant District Forester, Operation
Oscar Wold, Auditor

I came to Montana in 1907, arriving in Missoula on the 30th of May. I came here to accept a position with the Milwaukee and remained in that position until construction was completed, living in Missoula during the 1908 flood and the 1910 fire.

Mrs. Calkins and I were married in Missoula on July 9, 1908. Our wedding trip was a ride in a hack from the South Side around by the county bridge west of town to the Methodist parsonage where we were married and then back to the South Side. The driver sat on the high seat and was decked out in Prince Albert coat, silk hat, and white gloves. Some style! The county bridge was the only means of crossing the river after the flood.

There are a great many incidents I might relate of Missoula of that date, but can hardly take the time. Sufficient to say that it was a wide-open town. Besides the construction of the Milwaukee, the N.P. was double-tracking between Missoula and Butte, also making many line changes. H.M. Tremaine was a resident engineer for them at the time. Hugh and I worked together for the Chicago Great Western in Iowa in 1903-04.

After the Milwaukee was completed I was in Bonner for a year on the construction of the Blackfoot branch. During that time I became acquainted with John R. Toole, Kenneth Ross, and most of the men who are still there.

At one time I did some special work for Mr. Ross. When that work at Bonner was completed in 1911, I went to Hamilton with the Bitterroot Valley Irrigation Company, where I remained until I entered the Service.

Upon entering the Service on January 1, 1914, I worked until spring as a draftsman. About the first of June I got my first field assignment, to run a traverse along the Gravelly Range for about 25 miles ending near Black Butte. It is a beautiful country, and I recall that the grass that spring would brush the stirrups on a saddle horse. Flowers in great numbers and abundance and in a variety of colors grew there; to look across one of those meadows through the transit telescope gave it the appearance of an almost solid bouquet of flowers. Snowbanks still lay on north slopes under the brows of hills and in the heads of gulches. We generally set camp near one of these snowbanks to obtain water and have a cold place to keep our butter—the only perishable item in our supplies. I might add that these snowbanks were equally impressive as breeding grounds for a particularly vicious and persistent species of mosquito; also, to further assist me in occupying my time I had an ulcerated tooth the entire time I was on the job. The day we moved out, as though it had accomplished its mission, it quit aching.

The job was a transit survey to establish a base line for future range surveys. Stone monuments were established at half-mile intervals. On this work I had two young fellows as assistants and a camp-tender and cook, the latter part of the title being decidedly misrepresentative. I had always suspected that the man who occupied this position had had large experience as a sheep herder and that his culinary ability was limited to sourdough biscuits and mutton stew.

Our camp supplies and equipment were moved by wagon drawn by a team of horses. No roads were in existence in the area at that time other than rough wagon trails following the line of least resistance.

The survey was completed the last of June, and we started moving out to Sheridan. On the way out, I saw more sheep than I had ever seen before or since at any one time. The bands were just moving in on the range, and in

one day it was estimated that we could see 40,000 head at one time. The Madison Forest that year had issued permits for 125,000 head of sheep. Mr. Wilson was Supervisor.

Following the completion of this job, I returned to Missoula and was assigned as a resident engineer on the Bitterroot-Big Hole road then under construction. I moved to the project on the 5th of July and was there continuously until the 25th of October.

Transportation those days was, of course, much different than now. Very few automobiles were in use. I recall that in going to the project I went by train from Missoula to Darby, and by horse stage from Darby to Sula. From there on, it was every man for himself. I eventually landed at the Odell ranch on Camp Creek, which for a short time was my headquarters. There I met for the first time Ranger Than Wilkerson. Than was doing inspection work on the job. At that time the work had been under way for some time and was about 50 percent completed between the county road on Camp Creek and the divide.

This project, extending from the old road on Camp Creek near the Gallogly ranch over the divide and down Trail Creek to the Big Hole River near the historic Big Hole battlefield, a distance of 25.78 miles, was surveyed in 1913 by Frank Bonner. The type of survey employed was compass and Abney. A separate compass and Abney reading was recorded for each "shot" of 100 feet or less. This type of survey naturally resulted in considerable irregularity in both grade and alignment that was unnecessary, but in those days very little was known about the science of road location. Construction methods and lack of funds and equipment made economy in location and standard an essential requirement. At that time a common measuring stick in road costs by many counties was \$1,000 per mile.

The standards of construction were: maximum grade 6 percent, width about 10 feet; no minimum curvature was set, and I suppose some curves were as low as 20-foot radius. Culverts and bridges were constructed of local material, mostly lodgepole.

The type of material encountered over the entire route was fortunately decomposed granite, which made an excellent roadbed. This road has been used a great deal and has undoubtedly paid for itself many times over.

For many years, it had been the practice of stock ranchers and farmers in the Big Hole Basin to go to the Bitterroot in the fall with wagon outfits and lay in their winter supply of fruits and vegetables. This was no mean undertaking. There was an old road from Camp Creek and down Trail Creek, if it could be dignified by that name, and it was a good day's work just to ride this road in a wagon. The road left Camp Creek at Gallogly Springs and climbed the ridge to the divide for 2.75 miles with an average grade of 17 percent. I recall that there was quite an area at the top of the hill that had been cleared off, while at the bottom long, large windrows of trees lined the road on either side. Travelers coming down the grade would cut down a tree, tie it on the back of the wagon, and use it as a brake down the hill. The old road down Trail Creek was a nightmare, wandering around among the trees, up and down, over boulders and through chuck

holes. In the summer, there may have been a few short stretches of comparatively smooth road, but these were few and far between.

The job was handled by contract except for 1.7 miles on the east end at the battlefield, which was built by force account, with Than Wilkerson in charge and K.D. Swan as timekeeper. The work on this section was financed by every conceivable means short of highway robbery.

The contract for the Big Hole road was let to the Clifton & Applegate Company on a lump-sum basis, and they nearly went broke. The work was all done by hand labor and teams. The equipment consisted of gang plows, slip and Fresno scrapers, horse-drawn graders, and small hand tools. All rock, and there was quite a lot of it, was drilled by hand, double jack.

Clifton spent the entire season on the job as manager. With him were Allen, Howard, and Brice Toole. Allen was assistant manager, Brice was a timekeeper, and Howard worked as a laborer and he certainly held up his end of the load. Early in July, Clifton had Ole Rue come in as superintendent. Ole was one of the most competent construction bosses I have ever seen. It wasn't any time until he had everything organized and going full blast. Ole and I got along fine. We had a few arguments, but we both understood it was part of the game. Ole was not above taking advantage of any break he could get, and would cut the specifications if he thought he could get away with it, which was fair enough for it was up to the engineer to watch those things. I will relate a few incidents to illustrate what I mean. Occasionally on the route, bog holes would be encountered. In each case, the specifications required that all boggy material be removed and a backfill of mineral soil be placed. One day, Ole said to me, "Calkins, you know that bog hole at station so-and-so?" I said, "Yes." He said, "I don't see any need of removing that material. It's not very deep and a pretty good fill goes there." I said, "Well, let's go and take a look at it." So we went up there, and Ole got a crowbar from a crew working close by, put the small end down, shoved it in about 2 feet, looked up and said, "See?" I had my suspicions so I walked over, put my hand on the crowbar, and shoved it nearly out of sight. I looked up and said, "See?" Ole grinned and walked off.

The specifications did not require that a railing be placed on bridges of 10-foot span or less. The bridge foreman, John Lee, went ahead and put them on. One day, Clifton discovered this and nearly threw a fit. He jumped all over the bridge foreman, then jumped on me. "Why didn't you tell us?" he asked. I replied, "I am not running your job." Ole grinned.

In the case of some of the larger bridges, I woke up to the fact that the ground underneath was covered with bark chips and shavings, and as it was a dry season, it made a serious fire hazard and the specifications made no provision for cleaning them up. I spoke to Ole about it and told him, "Someone will drop a match or a cigarette there some day and we will not only lose the bridge but have a forest fire on our hands." He said he would put a crew on it, and I told him I would make it up to him some other way. He did, but when the job was about half done, Clifton came along and threw another fit. "Who told you to do that?" he asked. One of the men told him Ole did. "It don't make any difference," Clifton said, "we don't have to do that; you go back on the grade." They went; he was the

big boss. I came along later and noticed the work unfinished, so when I saw Ole I asked him why he pulled the crew off. He said, "I didn't, but I will find out damn soon who did." This time Ole didn't grin, but I did. He was a hot-headed Swede, and I knew there would be some fireworks. Ole hunted up the men and gave them a good dressing down. He told them, "I'm the boss on this job and if you want to work here you will do as I say." They went back and finished the job.

Ole wasn't satisfied to let it go at that but hunted up Clifton and laid the law down to him. "There ain't room for more than one boss on this job," he told Clifton, "so if you want to run things I'll go over the hill." Well, Clifton had quite a time calming Ole down, but finally did it, but it was easy to see it still rankled Ole. A few nights later, we were all in the office at headquarters camp and Clifton was talking to Allen Toole about some finishing work that had to be done up by the divide. He said, "We will have to put a small crew up there with a camp outfit." Then, turning to Ole, said, "Ole, who can we put in charge of that crew?" Ole looked up and growled, "You better go yourself; you're so damned anxious to boss somebody." Well, everybody laughed and Ole grinned rather sheepishly. He had gotten it out of his system. It is probable that in a short time the incident was forgotten by everyone except me. Ole was just a roughneck construction boss, but he knew the game and I learned much from him, not the least of which was that there isn't room for more than one boss on *any* job.

Compared to present-day methods and equipment, those in use at that time seem primitive to say the least, and the standard of survey and construction on this and other jobs was on a comparable basis. The result was considerable irregularity in grade and alignment.

Along Trail Creek for the entire distance, the survey held slavishly to the contour just above the level of the adjoining flats and meadows, which meant there were countless opportunities to "straighten out," cutting from point to point with light fills or turnpike sections, with the result of shortening the distance, improving alignment, and eliminating in most cases all clearing. However, with a lump-sum contract, it was next to impossible to make such changes. I did it only in a number of minor cases, nearly always staking both the original line and the revision and telling the contractor to take his pick. Without exception, they chose the revision. At Long Prairie, I could have made a similar but longer change that would have eliminated all clearing, shortened the distance one-half mile, and given a tangent location, but I was afraid of complications with the contract so decided not to attempt it. To this day, I am not sure I made the correct decision.

When I was assigned to the job, I was supposed to handle the engineering and Than Wilkerson the inspection, but as it turned out to be a rather bad fire season, Than had to leave, which threw the whole load on me. Then to further complicate matters, Bonner decided he wanted profile levels run from the divide to the battlefield about 17 miles. I asked him, since it was a lump-sum contract, what good that would do, but he thought it would help in checking finishing, so I said no more and managed to sandwich this job in some way and by working nights to plat it up. Later, Frank looked over the profile one night about 11 o'clock and finally remarked, "I guess we

better go to bed." That was the last of the profile, and I never felt it was my place to reopen the subject.

That summer, I was busier than a one-armed paper hanger with the hives. I had to have a helper, so I picked a tall Swede from the crew. He was well educated and apparently came from a good family. There was quite a number of Swedes on the crew, many of them just over and unable to talk English. They were smart though. Evidence of this lay in the fact that when I would come around they would bow and tip their hats. I wondered at the time if I shouldn't seriously consider moving to Sweden where I would be more truly appreciated.

The man I chose to help me had a difficult name so I renamed him King Oscar. King had a weakness for gooseberries, and one day when he had an opportunity, he stole a can from the kitchen and hid it in his shirt. He then went out in the brush and proceeded to consume the entire can, and considering the results, I have never been certain that he did not eat the container as well. Anyway, the next day we had a sick Swede on our hands. You could hear him groan for a quarter of a mile. Anyway, he lost his appetite for gooseberries. King Oscar served me well and faithfully for the entire season, and we became quite good friends in spite of the fact that he later turned out to be something of a crook.

The Big Hole road was completed that fall for a total cost of \$51,440 for the 25.78 miles, which includes the battlefield section 1.7 miles constructed by force account; of that amount \$18,955 was cooperative funds. I don't know how the contractor came out except that I know he didn't get rich at it. It was always my understanding they pulled out about even.

Transportation of supplies and equipment on this job was no small undertaking as it all had to be brought in by wagon with four to six horses over poor and difficult roads. I used to enjoy watching the "skinners" handling those teams. They certainly were artists at it, something almost impossible to find these days.

I think the honor of driving the first car over this road goes to Dr. Hayward of Hamilton. He and Al Rissman, a druggist of Darby, who was very active in promoting the road, and Rissman's boy came chugging through our camp on May Creek one night about 10 o'clock. I thought I was seeing things for a while. They didn't get very far before they ran "straddle" of a stump and had to walk back to the camp. The next day, they went on to Wisdom, then made the return trip.

We worked hard on this job, but in spite of that and the mosquitoes and horseflies, I would like to live those days over again. I would like to crawl into my bunk of fir boughs and have the coyotes sing me to sleep as they did nearly every night there. I would like again to meet the friendly people I knew there—John Clifton, Ole Rue, the Toole boys, Frank Bonner, Than Wilkerson, the Odells where we had so many satisfying and enjoyable meals, Al Rissman and Art Keyes and his wife, who nursed me through a sick spell at the Battlefield Ranger Station, and last but not least, King Oscar. All are scattered far and wide, some have passed on, and nothing is left to me but memories.

The last time I drove over this road, I was shocked to see comparatively large trees growing on the slopes of the cuts and fills. That was several years ago—I must be growing old.

The next year, signs, painted by Frank Cool, were put up on the road. The wording of two of these I think is worthy of recording here—one, on the sharp curves, "Go Slow and Signal," and the other, on turnouts, "Stop and Look Ahead." As to how well the injunction of these signs has been heeded by travelers, I leave up to the imagination of the reader.

A few years later when visiting the job with Than Wilkerson, studying maintenance problems, Than remarked, "We ought to have some kind of an open-top culvert to keep the water from following the wheel tracks." That was revolutionary and was a general shock to my sensibilities, but it was several years before the idea came into general use, an opportunity I let pass. They say opportunity is like a bald-headed man with whiskers; you can catch him coming but not going.

It was in 1921 that we undertook quite a large improvement plan for this project. This consisted mainly of replacing log culverts and small bridges with metal pipe. For 7 years, most of the original structures were in very bad shape.

In the fall of 1914, Bonner sent me to Priest River to do some survey work on a section of the road on the east side between the Experiment Station and the Halfway House, Prather's ranch. I was told to get in touch with Mr. Beardsmore in Priest River, who would take me out there. I landed in Priest River in the late afternoon and asked a man where I could find Mr. Beardsmore. He jerked his thumb over his shoulder and said, "Over there." I looked and saw a large ramshackle building, the St. Elmo Hotel. I then asked him where the best hotel was, and he said, "That's a good one; come on, I work for Beardsmore, I'll take you over." I realized I was stuck and went, but to this day I can remember the musty odor of many cookings of corned beef and cabbage from the kitchen and of drying socks around the big base burner in the lobby.

The next morning, Beardsmore and I started out with a team and buggy in what for that country of historic rains must have been one worthy of recording. It took us most of the day to reach the Halfway House, where I met Mrs. Prather and was installed in a room in a large cabin. In the front room, I noticed an old man sitting in a rocker. He was Tom Benton, Mrs. Prather's father. I walked around the room and noticed a picture on the wall; it was a picture of Andersonville Prison. I had seen it before, as my father had one. I turned to the old man and asked him if he had been there. He grunted. I then told him my father had been there for 11 months. He said, "What State?" "Illinois," I replied. "What branch?" he asked. "Calvary," I told him. Then he asked, "What regiment?," and I could see his interest increasing. I told him, and he said, "The hell you say; what was his name?" I told him, and he jumped out of the chair like he had been jabbed with a pin. "My God, are you Fred Calkins' boy?," he yelled. I said I was. After he got over his excitement, we had quite a visit. Dad was living then, and I wrote him. He told me Tom Benton had been the only member of his squad he had been unable to get any trace of after they left prison. They had gone through the war and prison together.

I mention this here, since it seemed to me a strange coincidence and as further proof that this is a small world.

In the spring of 1915, my first assignment was the construction of the section of road near the Halfway House. Of course, those days the Forest Service had no equipment for construction. Slim Borden had been a contractor in a small way and had a small outfit, about 30 head of horses, plows, Fresnoes, scrapers, etc. He had worked on the Big Hole road the season before on a subcontract, so we hired him and rented his outfit for the Priest River job.

As soon as the outfit arrived in Priest River, Fred Forsythe, who was then Deputy Supervisor, took me out to the job so that I could select a camp site and get it ready. As all the tools were on the cars, Fred took me to the Experiment Station to borrow some tools to set up camp. Brewster was in charge at the time but was absent. Larson let us have what we needed. Later, when I returned the tools, the axes were sent back with a formal note from Brewster saying that they were not the axes that had been loaned me, that their axes were special "Sager chemical chopping axes." I asked Johnny Lee if he had seen anything like that. He said he hadn't. Johnny was a Swede, and called them "Sager comical shopping axes." We finally picked out six of the best axes on the job, sharpened them well, and returned them to Mr. Brewster, with the information that that was the best we could do for him. I don't think Brewster ever forgave me for that.

Those days, we had no practical means of paying the men on the job, and as that would be necessary in handling a lot of transient labor, arrangements were made with the Kendall Mercantile Company in Priest River to furnish us with all supplies at 10 percent off. For this, they agreed to pay the men on presentation of an authentic statement. We had no form for this purpose, so Kendall and I marked one out. I made these in camp on an old Oliver typewriter, six at a time. They were on a half-letter-size sheet of yellow paper and were a combination of check and receipt. I also had an old check protector that I used. It was intended that these would be cashed in Priest River by Kendall, but it wasn't long before the canceled "checks" started coming back from other points, nearly all of which were cleared through Old National Bank in Spokane. I was flabbergasted, but in all of this, involving hundreds of dollars, we never had the least trouble and our accounts checked in to a penny, which I thought was some sort of record.

The winter before, the Forest had cleared the right-of-way and attempted to shoot the stumps. On the large stumps, they didn't use enough powder and only split the stumps into several snags that could only be disposed of by pulling, and it took some pull. To do this, I bought 125 feet of 0.75-inch steel cable and two large double blocks.

A stump rancher in the locality had a family, a cabin, and a team of horses. The horses were perfectly matched blacks weighing 1,700 each and perfectly trained to pull. I was never sure which rated the highest in McCloud's affections, his family or his horses. I never saw his family, but know he had reason to be proud of his horses. We put them on the cable, and when they started to pull, you could count on one of the three things happening: either the stump would come out, or the clamps on the cable would slip, or the rigging would break. It was a treat to watch them work.

I was glad when this job was finished for we had worked in rain and mud most of the time.

For the balance of the season, I was on location surveys. The first job was to make a location survey from Prichard, Idaho, upriver to Big Creek. My instructions were to locate so that the line could be used for either a road or a logging railroad. The present road follows substantially the location made at that time. The railroad that came later bridged the river twice to take advantage of flats and avoid sidehill grading. The lumberjack hates a pick and shovel worse than a cowboy hates digging post holes. If he has something to build and can possibly build it of logs he will do so, and in many instances makes the mistake I have seen happen so often in our own work of mistaking cheapness for economy.

Nothing much worthy of note happened on this job. I had a good crew, and the work went smoothly. Bonner made an inspection trip, and with him came Dan Conner, who was the fire organization. While Bonner and I went over the location, Dan borrowed one of my axemen and went back in the hills and built a test fire "just to see if the boys were on their toes." They were; and if Bill Newberry could have caught the "----" that set that fire he would have made him hard to "ketch," or words to that effect. Bill was Ranger at Prichard and he had a voice like a foghorn. I have been on the trail on the opposite side of the river from the Station and have heard Bill talk on the phone and got every word he spoke. I said to him one day, "Bill, when you want to talk to Coeur d'Alene, why don't you just stick your head out the window and talk; why bother with the phone?" Bill was pretty good natured, as most big fellows are.

The natives had a unique and interesting method of freighting up the river. They would hitch a horse to a flat-bottomed scow loaded with freight and walk it right up the river; then the horse would be brought back on the trail and the boat floated down the river.

The type of survey made was a standard transit location, and the crew would consist of six to eight men, an instrument man, rodman, chainman, stake artist, and two to four axemen as conditions required.

The methods employed were as follows: I would work ahead with the axeman, establishing and clearing the line and setting the flags for the transit crew to follow. The transit crew followed, staking the line, chaining the distance, etc. After this was done, I would divide the crew to run profile levels, cross sections and topography, take section-line ties, dig test pits, make notes on soil classification, clearing, and cutouts and bridges, etc. The methods and organization just described apply equally, with minor variation, to all subsequent location work and will not be repeated.

In all my locations, it seemed I had almost phenomenal luck in missing obstacles on the ground with my lines. On this job, in producing a tangent across the Big Creek flat, I saw a large double cedar snag looming up ahead in the brush. I thought, well, here is where we offset. The snags were each about 4 feet in diameter with only about a foot of space between, but the line went right through the center of this opening. It was something the boys couldn't understand, and of course I made no attempt to enlighten

them but would say nothing and try to look mysterious, but I wasn't fooling the instrument man.

Max Mullen was a young man from Wallace whom I had hired as an axeman. His family had previously lived in Missoula and I was well acquainted with them. Max was a big husky lad and a good worker but about as graceful as a cub bear. One day while we were running the line across the Big Creek flat, we came to a place where a tall slender lodgepole had arched over with the top right on the line. I told them to "get it" and paid no more attention for a time. When I looked around, there was Max up on the arch of that tree, 12 feet above the ground, chopping. I yelled to him to get down, but just then the tree broke with a bang like a cannon and with apparently about the same propulsion. The axe went one way (fortunately) and Max the other, but the god that guides the destinies of fools and drunks must have been looking after Max for he suffered nothing worse than a few scratches.

Our next job was to be the location through the Fourth of July Canyon. We moved by train from Prichard to Cataldo, where I made arrangements for transportation by team and wagon to the canyon.

Our outfit, consisting of rolls of canvas, of tents and bedrolls, personal baggage, surveying equipment, etc., was strung out on the depot platform while the boys were lounging around in the warm sunshine smoking and enjoying their brief vacation. I noticed an old gentleman at the other end of the platform trying without marked success to strike up a conversation with the boys. He was a benevolent looking old fellow with long snowy-white hair and beard. Cataldo, then, was a quiet sleepy little village. There was no paved highway with the rush of cars, trucks, and buses. It was easy to see the old man was fairly consumed with curiosity. He walked slowly up to the platform to where I and Paul Bebe were sitting. The old man stopped a few feet from us and with his hands clasped behind his back and his head bowed in thought finally turned to Paul and said, "Do you know what the elevation is here?" Paul replied that he did not. The old man thought for a little longer, then remarked, "I don't jest recollect, but I'm pretty sure there was a seven in it accordin' to the theological survey."

Our survey was to start at the canyon schoolhouse at the point where the Rose Lake road turned off and ended at Bennett's Bay, a distance of 22 miles.

Our first camp was at the logging camp of the Rose Lake Lumber Company in the canyon about 2 miles above where the survey was to start. It was there I first met Bill Keeler, logging superintendent. I also met Walter Rosenberry when I went to Rose Lake to make arrangements for accommodations at the camp.

For many years to follow, I was to come in direct contact with Bill Keeler, and in all our dealings I found him fair and cooperative. He was a fine man.

In addition to our camp with the Rose Lake, we camped at the Thompson ranch just over the ridge to the west of Cedar Creek, at the VanDusen place

near Wolf Lodge, and the Molstead ranch on the west shore of Blue Creek Bay.

On this work, our crew was joined by J.J. McCready, representative of the State of Idaho. He worked with us on the entire job and held up his end the same as any member of the crew.

Mr. Molstead was a Norwegian and had sailed many a boat on the fjords of Norway, and love of the water was in his blood. He owned rowboats, two or three small motorboats, and one fairly large steamboat, probably 50 feet long. I made arrangements with him to furnish us with boat transportation. They would take us out in the morning, and I would tell them where to pick us up in the evening. The section of survey we worked from Molstead's ranch extended from a point well above the Wolf Lodge bridge to Bennett's Bay. The work took between 2 and 3 weeks. In addition, he took the entire crew to Coeur d'Alene one Sunday on the steamer so they could take in a picture show, and when I settled up with him, my bill for boat service was \$14.

I had two of his sons working for me as axemen, and I never had more efficient or hard-working boys than they were. One of them worked so hard one day he fainted.

All of these things contributed to the low cost of the survey, which was about \$50 per mile. All of my surveys of this type ranged from \$50 to \$70 per mile, but those days we hit the ball, and I didn't worry about being back in camp when the whistle blew or getting courtmartialed.

Mr. Wilbur lived in a large fine house on the shore of the lake in a cove just east of Bennett's Bay. I was carrying my line rather high (the present road is on that location), and as his land extended back quite a way from the lake it meant that I had to cut his land in two. Wilbur didn't like this because he had a couple of milch cows that pastured on this land. He wanted me to put the line down on the lakeshore in front of the house. I couldn't use a low line through there due to excessive cost. I explained this to Mr. Wilbur, and after I had convinced him I couldn't do it, he was satisfied, but I told him we would give him a stock pass under the road in a gulch back of his place. This was more than satisfactory. A few years later when I happened in Coeur d'Alene one Saturday, Wilbur was in town and looked me up to tell me that they had made a fill across the gulch. He was quite downhearted. I told him not to worry, that it was an agreement made in good faith, and I was sure that it could be adjusted. When I got to Missoula, I took the matter up with Mr. Keene of the BPR and he said they would fix it. They opened up the fill and put in the stock pass, and Mr. Wilbur was sitting on top of the world.

But to get back to the survey. After I had made the above arrangement with Mr. Wilbur, he invited the entire crew to a chicken dinner. After living on sandwiches for lunch every day, a chicken dinner was a real occasion, and everyone made the most of it. The net result being, we didn't get much done that afternoon. After work, Wilbur loaded us all on his yacht and took us back to Molstead's. There are some fine people in the world if you give them half a chance.

At the time this survey was made, there was very little travel by automobile, and cross-country travel was limited to an occasional stout-hearted individual in search of a record of some sort. The standards adopted for the location were equal to those in use in Idaho and ahead of anything in use in Montana at the time, yet the road had hardly been built before it was evident that the standard was much too low. No one had any means of estimating the great increase in volume and character of travel that was to come in a few short years.

The matter of finances was another difficult problem. The first section of this road, the Burns Summit section, was constructed by the Forest Service and was financed by the State of Idaho, Forest Service funds, county funds, and local subscriptions, and toward the end of the season, the job was operating on a shoestring, sort of a "now, if we can scrape up a few more dollars we can finish this cut" basis.

The winter following this survey, I made the design and estimate, and as I recall, the estimate was between \$6,000 and \$7,000 per mile. This was unheard of; it was heresy or something; who ever heard of spending that much on a road?; etc. Booth, Idaho State highway engineer, was in Missoula when I finished the estimate, and, although they didn't say so, I know darned well they thought (and hoped) I had made a mistake.

The road had been designed for a width of 16 feet, so they decided to try a 14-foot width, and I redesigned the job, and the result was a reduction of 12 percent in the original estimate, and so they decided to go on the 16-foot basis.

I attended a luncheon at the old Banquet Restaurant in Wallace, where several speeches were made and where a lot of enthusiasm was ginned up to help finance the work. Bonner had picked me up off the job to make this trip, and the car I rode in had a driver with one eye. He took us through over the narrow, crooked dirt road to Wallace at the phenomenal speed of about 30 mph. After we arrived in Wallace and I had time to press my hair back in place and catch my breath, I remarked to one of the other men, "I'd like to see what that fellow could do if he had two good eyes."

Altogether, my experience on this job was interesting and satisfying, and new friendships gained. I have lived to see the road built on my location and later revised on a more desirable route until only one section of the original location now remains, from the Wolf Lodge bridge to Bennett's Bay, and plans for changing this are in the making. It will be pulled down to a water grade with easy curves and long tangents, and the cost will probably be in excess of \$100,000 per mile, a far cry from the original estimate, but it is well justified by traffic requirements.

Except for the proposed bridge across the mouth of Blue Creek Bay, I can honestly say that not a foot of the revisions was planned or accomplished but what I examined. But for obvious reasons, they were beyond our reach at the time. Coventry, who was county surveyor at the time, and I together examined the route down Cedar Creek from Burns Summit, and years ago I told Andrews of the BPR that that should be one of the first changes made, and it was. I derive no small amount of comfort from these thoughts.

After completing the survey of the Fourth of July Canyon, I was sent to Grangeville to retrace a previous survey from the Cove Placers down into the S.F. Canyon to the point where the old trail crossed the river. A large boulder in the middle of the stream served as a pier for the bridge.

As we were traveling on the train up the Culdesac Canyon, Bill Wilson, my instrument man, disclosed that he had been resident engineer on the construction of that section through the canyon. He got quite a kick out of seeing the old "battleground."

The road from Cove Placer had been surveyed some time before, and a section on the upper end had been constructed by George Ring, who was supervisor then. I think this was done in 1913 or 1914.

The purpose of the resurvey was to obtain a more reliable estimate of the cost. Later the plan was abandoned in favor of the present route into the South Fork, and I suppose now it would be difficult to even find a sign of the original construction where George Ring used to make stump speeches to his crew.

Thus ended the field season of 1915, and the winter was spent in designing the summer's work.

In 1916, the first job was the retracement of the Wolf Lodge survey. On this work, my crew consisted of J.J. Crell, instrument man. Crell was a high school teacher from over in Washington some place and was pretty much of a tenderfoot in the woods, but a conscientious and capable worker. Hugh Kent, rodman, Bill Richardson, chainman, both from the University at Missoula; Clarence Piedmore and George Ames, axeman; John Ward, cook and ex-preacher, and I might add that he possessed none of the characteristics of his earlier calling unless it might be a serious mien and a rumbling baritone voice. I think he was the surest cook I ever had to contend with. Also with the crew, since we were to complete the design and plans in the field, I had Jean Ewen as draftsman and J.H. Miller as designer.

This was one of the toughest jobs I ever had, due to steep slopes, brush and timber, snow and rain, long hard hikes, and working all the time with grades up to 10 and 12 percent. I was soft and about 20 pounds overweight when I went in May 10, and on July 15 I walked from the camp on Sands Creek over the old Skookum Trail (17-percent grade) to the Searchlight Mine with a transit on my shoulder without stopping.

The project started on Wolf Lodge Creek at the mouth of Marie Creek and ended at the mouth of Sands Creek on the Little North Fork a short distance above the Honeysuckle Ranger Station. The distance was about 12.5 miles with a total rise over Wolf Lodge Summit of about 2,000 feet.

We camped first at the Pietromuex ranch on Marie Creek, then at the Searchlight Mine, and last at Jerry Alcorn's logging camp on Sands Creek.

There were two or three incidents that occurred on the job to break the monotony for the boys. There was the time Jean Ewen rigged up a cigar can with two holes in it for eyes and a candle with an ingenious shutter worked with a pendulum that when swinging would make the eyes blink.

When Crell saw this about 10 o'clock one night, he nearly tore the tent down getting in to get my rifle. He shot at it three times, and the third time hit and put the light out. "I got him!," he shouted, and the boys started heaving rocks in the brush to give the impression that it was wounded and headed down the creek. It being dark, he couldn't see what they were doing. They ran Crell nearly a mile down the creek before they gave it up. When they came back, Crell began to grow suspicious so he took a lantern and went out in the brush and hunted until he found the can. He brought it in, held it up, and said, "Well, anyway, I hit it every time." He was too excited to notice only one hole went clear through the can, but he took it in good spirit and was one of the gang from then on.

One frosty morning, we went out to work, and Ames was looking at a large clump of willow brush. He said, "I suppose that has to come out?" I told him it did. He walked up to it and gave it a half-hearted blow with his axe, and one of those thin wiry switches cut him across the face. It's bad enough to have that happen any time, but it's almost unbearable when your face is cold. Well, George just exploded like a box of TNT. For a few minutes, the "blue" air was full of flying brush and dust. When the cyclone passed and George stood there red in the face and panting, I said, "George, bring me one of those switches." He looked at me suspiciously and asked, "What do you want with that?" I said, "I think I will carry one with me." George grinned. He got the idea, but I didn't get the switch.

Decker Brothers, well-known packers at the time, had a pack base established at the Searchlight Mine. They were to pack for the Rose Lake Lumber Company. They moved our camp to the Sands Creek camp, and I saw those mules with 200-pound packs climb up over a log obstruction like a bunch of lumberjacks. The packer put his horse up the steep slope around the logs, but evidently the mules thought that was too much trouble.

As we moved off this job, construction was starting on the lower end of Marie Creek with Bob Gumaer in charge. At the same time, construction had started on the Burns Summit section of the Fourth of July Canyon with Chester Cheatham in charge. Chester had the longer and more important job, and Bob was jealous. They used to go to Spokane to buy their supplies, and Bob, not to be outdone, would order on an even more lavish scale than Chester, with the result that he had a large amount of supplies in storage on the job, enough to feed Coxey's army for a year. Without exaggeration, we fed prunes to our road crews for the next 10 years that came from the Wolf Lodge job. Bob ran out of funds before he got the road to the Big Spring. Poor Bob; I thought a lot of him, but he had a jealous and sensitive disposition and a bad temper, and yet could be so friendly and fine. He had a lot of native ability and had practically raised himself by his bootstraps, but was unable to overcome his handicaps. Bob and Chester have both passed on, but the recollection of my association with those boys is one of my treasured memories, for I knew what was under the surface.

Our next job was the location of a section of the Yellowstone Trail immediately west of Alberton, Montana.

The old road was on the north side of the river above the Milwaukee tracks and passed over what is known as "Nigger Hill." The road was crooked and steep and one of the most difficult sections on the route. The road

crossed the river on a low bridge at approximately the site of the present crossing.

Since the bridge must be replaced, the State had made surveys and found a location just west of Alberton where the river was narrow with a natural pier in the center. The State estimated they could build a bridge at that site for \$10,000 less than it would cost to replace the existing bridge; therefore, that amount had to be considered in our selection of a route.

I camped first at an abandoned ranch on the north side on Nigger Gulch. My crew was small since I required no regular axeman. Hugh Kent was instrument man, Bill Richardson rodman, H.E. Webb, chainman, Jean Ewen on cross sections and topography, and J. Yelland, cook. He was the neatest and cleanest cook I ever had, and the only mistake he ever made was that one day he used salt instead of sugar in making cream pies. That was a mess.

I found that a route above the Milwaukee tracks was out of the question so made a survey along the approximate route of the present highway between the tracks and the river, but the estimate for this was way out of reach. I then moved my camp across the river. To do this, it was necessary to go to Lathrop and over by train to Plateau, a flag station on the N.P.

When we went through Alberton, I bought a pocketful of nickel cigars, but I had no idea at the time what a worthwhile investment that would prove to be. When we got to Lathrop and unloaded our junk, it made quite an imposing pile on the platform, and I guess it didn't make much of a hit with the agent for all I could get out of him was an occasional grunt.

Pretty soon a freight train came through, and he had to come out of his cave. I got him cornered and said, "Have a cigar." He brightened right up and said, "Just as soon as this train pulls out, I'll fix you up." He was as good as his word. He looked over the stuff and said, "You know, I think we can check practically all of this as baggage," which he proceeded to do. It took almost as long to load and unload the stuff as it did to make the run from Lathrop to Plateau.

The conductor and baggagemen nearly threw a fit when they saw the layout, but a couple more cigars changed frowns and grumblings to smiles, jokes, and willing cooperation, and as the train pulled out of Plateau, they waved and shouted good luck. The boys never ceased to marvel at what the judicious use of a few nickel cigars could accomplish.

The location on that side proved much easier and cheaper due partly to the saving on the bridge, although it included one section of heavy work west of Plateau where it was necessary to use several hundred feet of dry rubble masonry wall between the railroad and the river and included two grade crossings on the railroad. The wall gave considerable trouble later in two or three places.

Mr. Purcell was then bridge engineer for the BPR at Portland. He came over and viewed the location and approved the plans for the wall. I felt much better. The estimate for this project was about \$10,000 per mile. We were beginning to get into big money.

The next project was the location of the Gibbons Pass route. Both the Big Hole and the Bitterroot were interested in this connection with Salmon City. The route selected was from Gibbons Pass north along the divide to a connection with the Bitterroot-Big Hole road a short distance east of the divide. Such a route served both communities equally well, but a few people on the Bitterroot side wanted the road to go down Camp Creek through Gallogly Hot Springs. This would have been fine for the Bitterroot but no good for the Big Hole.

Ravalli County planned to cooperate with us in the construction of the road, but the commissioners could not agree on the route. Taylor, Edwards, and Bob Harper were the commissioners. Taylor was in favor of the route selected; Edwards wanted the route down Camp Creek, said he could build a road down there for a thousand dollars a mile; and Harper was from Missouri and had to be shown; so a trip was arranged and the commissioners, Nick Blindauer, county surveyor, George Lautz, and myself went.

I knew the commissioners were not used to hiking and would soon tire, so I took them over the selected route first. This was easy traveling and they enjoyed it, but by the time they reached Gibbons Pass they were getting tired. They questioned me some about the other route, and Taylor and Harper said they were going down the trail. Edwards hated to admit he was licked, but was too tired to care much. He finally told Nick to go with me and he would be guided by what Nick reported. Nick and I started out. It was steep sidehill, rocky and brushy, and after we had gone about a mile, Nick said, "How much is like this?" I told him it was all like that or worse until we hit the creek bottom. He said, "Oh hell, let's go down to the trail." And that was the end of a perfect day.

At the end of this job, the crew was disbanded, and Kent and Richardson returned to school. On October 4, I left for Grangeville to make a reconnaissance survey up the South Fork of the Clearwater to Elk City. First, however, I organized a small crew and made a compass and Abney survey from Mount Idaho down into the canyon to the present bridge site, then upriver to the trail to Castle Creek. The present road was built on this survey.

After completing this work, I returned to Grangeville to arrange for the reconnaissance to Elk City. On this trip, Tom Crossley, who was the ranger at Castle Creek, was to accompany me. Also, we had a short string of pack mules and James Gribble as packer. We left Castle Creek on the morning of October 25 and reached Elk City on October 30, averaging about 6 miles per day. The total distance was slightly under 37 miles.

Anyone who has seen the S.F. Canyon need not be told that it is for the greater part a very rugged canyon. At that time, a trail of sorts followed the river. It had been built many years before by miners, probably during the gold boom. It was a poor excuse of a trail, and some apprehension was felt for the pack string, but Jimmy took them through without a scratch.

One fortunate circumstance was a big help on this work. Several years before, the N.P. Railway had made a survey up the river, and I had a copy of their map giving the station number at each creek crossing. It was

therefore only necessary to pace for short distances in between breaking down the work into typical sections.

I enjoyed every minute of this trip. We had good weather up to the last night, when it rained, then it turned into snow, but that night we reached a cabin. It was a good cabin, but securely padlocked, and there we were on the outside looking in. Tom had a screwdriver, I had an idea; we took the lock off and took possession. Let 'er rain and snow; we were fixed. The day before Tom had killed a deer with his Luger, and that night we had venison stew, stewed peaches, bannock, and coffee. Believe me, there is no finer combination in the world. Tom was an artist at making bannock, and I was no less proficient at disposing of them. Our plan of work was that in the morning Tom would describe the country ahead and I would estimate about how far we could go. He would then tell Jim where to camp. Tom and I would take our lunches and start out. Jimmy would pack and clean up camp and move to the next site and when we came in would have camp all set and supper on the fire. I shall always have a warm place in my heart for Tom Crossley for his unfailing cheerfulness, friendliness, and helpfulness. Tom will do to take along.

We reached Elk City on the evening of October 30. The next day at noon, I said goodbye to the boys and started out on the stage. This was a four-horse setup, and I rode on the seat with the driver, and we buckled ourselves in with heavy straps, a wise precaution I was to learn. That night I stayed at the old road house at Newsome and left early in the morning with a different driver. The road from Newsome climbed for 9 miles, and all that time we traveled in a dense fog.

There were no other passengers, and I visited with the driver, talking of various things. He didn't know who I was, and apparently he took me for a tenderfoot, since many came in looking over mining property. To make conversation, I said, "I suppose there are lots of bear around here." "Oh, quite a few," he replied. "Any grizzlies?" I asked. "Some," he said. "They are pretty tough customers, aren't they?" "Well, they are supposed to be," he said, "but I know different." "How come?," I tossed in, to find out where this was leading. "Well, one Sunday," he offered in explanation, "I was out for a stroll in the woods, and I came to a small park, and on the other side of the park was a big grizzly!" (In all bear stories, the bear is *big*.) "When he heard me, he sat up and looked at me. At first I wanted to run, but as he didn't act like he was going to do anything I waited, then I got to wondering if they were as bad as I had heard. I started walking toward him slowly, and finally I was almost close enough to touch him, and still he did nothing. Finally I took off my hat and, leaning toward him, I gave him a stiff clout on the snout. He turned and ran away."

"Gosh!" was all I could think of to say; and I suppose he thought, "The poor boob believed it."

Finally, we came out on top and into bright sunshine. There at our feet lay a great ocean of clouds stretching as far as the eye could reach, with here and there a moutaintop piercing through like islands in a great sea. It was a sight that beggars description. The driver had stopped the horses, and when we started I hated to leave, and I am sure he felt the same way.

It was during the winter of 1916 that the BPR made arrangements to establish a branch office in Missoula, and it was after much head scratching and conversation that the four horsemen, Cheatham, Williamson, Gumaer, and myself, decided to transfer over, which we did effective January 1, 1917. All the time, though, I felt like a deserter. The BPR was a fine organization with fine men, but something was and still is lacking—that fine idealism of the Forest Service—and so on February 16, 1918, I came back. Eventually Cheatham went to Alaska, Williamson to Denver, and Gumaer left to go into business for himself.

E.S. Wheeler was put in charge of the local office, which was under J.A. Whittaker, District Engineer, at Denver.

Wheeler was a fine, upstanding man, with a keen sense of humor and a wonderful command of the English language. I have seen him curl his upper lip and deal out sarcasm in \$10 words for 15 minutes without once repeating himself, and it was this accomplishment that got him in dutch with the Montana Highway Commission. The commission was infant in years but not in size. If I remember correctly, there were 25 members.

Wheeler's 14 years' experience had been in some of our island possessions (I've forgotten which) where a magnanimous government was building concrete paved highways, and that was all he could talk about. Montana's need then was to improve the roads and surface them with gravel. It was some time before Wheeler began to get a true perspective of the situation in Montana, the third largest State in the Union, with the costliest construction, a total population that would make only a fair-sized city in most States, and no source of revenue. Wheeler, I think, had been born 30 years too soon.

During the year 1917 while I was with the BPR, I made location surveys for the road on the west side of Seeley Lake, the North Fork of the Flathead, and reconnaissance surveys for the Skalkaho and the Clark Fork. All of this took from May 19 to November 22. It was a fairly busy and active season.

The Seeley Lake job was a compass survey, and I hired Hugh Kent as assistant. Wheeler went along for a "vacation," and Ezra Shaw, ranger at Seeley Lake, and Ed and Jay Perro worked on the survey. We stayed at the ranger station, and the evenings were devoted mainly to telling windies. It was a short horse, easily carried.

On June 24, Hugh Kent, Grant Higgins, who was now a member of our crew, and I went up to the North Fork to the Moran Ranger Station to start that survey. We traveled from Columbia Falls by team. The road was in too bad shape for a car or we would have gone by "jitney," a somewhat doubtful method of locomotion just coming into vogue.

At Moran Ranger Station we met George Stepler, ranger. Mrs. Stepler agreed to board us, and George had a large tent up in the yard he said we could sleep in. There was nothing in the tent, so we all made our beds down in a row along one side.

The mosquitoes were terrific. As near as I could tell, they worked two shifts. The early shift would start about 4:00 a.m. and work til noon, and

the late shift would work from noon til 10:00 or 11:00 p.m. I finally sent to Columbia Falls for a bolt of mosquito netting. We fixed this in a canopy over the heads of our beds.

Grant Higgins was, and I suppose still is, a quiet, reserved, and undemonstrative individual, and you never knew what he was thinking about except you could be sure he was thinking. When we went through Kalispell, Grant, without telling anyone, purchased a bunch of firecrackers and put them in his pack sack. On the morning of July 4, about 4:00 a.m., he very quietly slipped out of bed, got the firecrackers, and laid them next to the canvas on the outside about a foot from my head and lit them. I tore the mosquito canopy down, tore my bed apart, and nearly pulled the tent down getting out. It was one time I saw, or rather heard, Grant laugh real hard. I know his sense of humor took nourishment from this incident for a long time. At that, it must have been kind of funny.

The second camp was at Bill Adair's store. I will mention one thing about the store that impressed me. The building was of logs, one room probably about 20 by 40. The ceiling was high, and the ceiling joists were of hewn timbers. The work was so well done that unless one looked closely it would be assumed the timbers came from a sawmill. There were some real broadaxe artists in the locality.

The third camp was at Dad Cooper's ranch on the Meadow Creek bench, the fourth near the Ford Ranger Station, and the fifth and last camp at Ralph Thayer's homestead on Trail Creek.

This was a compass and Abney survey and extended from Coal Creek to the International Boundary, 30 miles.

The only feature of the job that I feel is worth mention was the right-of-way situation. Practically the entire route lay across privately owned land. I knew that any attempt to placate one owner would lead to complications with the others, and decided that the best plan would be to go ahead as though there were no private ownerships. This proved to be a fortunate decision.

A.G. (Andy) Vance worked for me all during the survey. Andy had a ranch in the river bottom not far from Adair's store. Andy did all my packing and furnished saddle stock, and also kept me posted on the grapevine rumors. Andy was one of the finest old fellows I have ever known, a real gentleman. He was a quiet, unassuming, and friendly man, but had had quite a colorful career. In his younger days, he had hunted buffalo; later he sold elk meat in Livingston before there were any game laws. For several years, he had been a guide for big-game hunters through the Rocky Mountains from Colorado to Canada. During this time, he had Count Zeppelin on one trip, and at other times a famous lord and wife from England. Andy had also been in the Alaskan gold rush.

Dad Cooper had a hard reputation. He was reported to have vinegar in his veins rather than blood, and the grapevine said, "Wait til he tries to run his survey across Dad Cooper's place and see what happens."

One day Andy and I were riding up the trail to look over some country ahead, and we met Dad. Andy introduced us, and I told Dad I would like to camp at his place and board the crew with them if it could be arranged. Well, this rather surprised him, but it was so arranged.

While we were there, nothing was said by either of us about the road until one noon I brought the survey across his line in sight of the house. After dinner he asked me if I was going to put the survey across his land that afternoon, and I told him I was. "Do you mind if I come out and see where you put it?" he asked. I told him no, that I would be glad to have him. I told him where I planned to put the line, but I said, "I can swing it over that way more; if it makes any difference to you, state your preference and I will follow it." He thought it over for a while and indicated his choice. It really made no difference, but he was satisfied.

Nothing more was said about the road until the morning we were to move. After breakfast when the others had left the table, Dad turned to me and said, "You heard down there," and he jerked his thumb over his shoulder toward the river, "You heard down there I was a pretty tough customer to get along with, didn't you?" I said, "Well, maybe I heard something of the sort, but I hear lots of rumors and I don't pay attention to them." The old man looked at me with kind of a sly smile and a twinkle in his eye and said, "We fooled 'em, didn't we?"

It was while we were camped at Thayer's homestead that Wheeler took a notion to visit us, and he brought Mrs. Wheeler. They came in the hard way, with a team and driver from Belton, coming up on the park side. When I heard they were coming I sent Andy out to meet them. He had to take a roundabout course to find a suitable ford, then bring them across country to camp. There was no road, but they finally made it. I think it was after the trip that Wheeler began to have some conception of the size of the State and to understand the difficulties that confronted the road program.

The Skalkaho reconnaissance was on the southern route, coming out by way of Medicine Lake and the upper West Fork of Rock Creek. About all there is to be said of this job is that it was darned hard work. Long hikes, hard climbs, and no trails. The country was steep and rugged, and long hikes were necessary due to the difficulty of placing camps.

The survey was with Abney and army sketch board. The distance was chained roughly, but with that type of survey quite a distance could be covered in a day.

The same type of survey was employed on the Clark Fork Plains to the State line, but this was a "luxury" job. We actually rode to and from work in a car and lived in town.

The fact that the cars were Ford jitneys of all descriptions, the roads rough, narrow, and crooked, with steep hills, detracted nothing from our enjoyment of a unique situation. It was nothing short of a vacation.

The work started on October 29 and was completed on November 20. We had covered 71.62 miles. The cost of the survey was \$8.00 per mile.

Beginning with 1918, the year I transferred back to the Forest Service, I was no longer assigned to seasonal jobs of road surveys but was assigned to minor roads, survey, construction, and maintenance. Now, all large jobs, major roads costing over \$5,000 per mile, would be handled by the BPR.

In 1918, I spent practically the entire field season on the construction of the Wolf Lodge, completing the project from the end of earlier construction near the Big Spring to the "Little River" at the mouth of Sands Creek.

The work was handled by contract under a cooperative agreement between the Forest Service and the Rose Lake Lumber Company, each providing 50 percent of the cost. The contract was awarded to G.A. Carlson of Spokane on a cost-plus-10-percent basis, and the construction was nearly all accomplished through station gangs. These gangs were generally made up of five to seven men. They would contract to build a certain amount of road at so much per station. Out of this they would pay board, rent tools, buy powder, etc. On this project they made from \$4.00 to \$8.00 per man per day, clear of expenses. I have known station gangs to make \$24.00 per day, but that was unusual. I have carefully checked them repeatedly and found them averaging 20 cubic yards per day per man for 8 hours. At the same time, 5 to 7 cubic yards per man was the best that could be obtained by day labor. They would not use a long-handled shovel. They called it the "lazy man's shovel." The entire job was built with pick and shovel.

While I was engineer on the job and representing the Forest Service, before I got through, I was representing the Rose Lake Company and practically running the job for Carlson. He was away quite a lot. I learned a lot from Carlson on dealing with station gangs. Carlson was a fine man, scrupulously honest and upright in his dealing with these men. He understood them and sympathized with them. He had come up the hard way, too. He was a pirate when it came to bidding on work; when he wanted a job, he wasn't afraid to bid for it.

Carlson built a good many of our major roads, such as the Lochsa, Cash Creek to the Bungalow, North Fork of the Flathead, and many others.

Carlson was a large man, about 6 feet and weighing around 235 pounds, with a prodigious appetite. One evening when he, George Lautz, and I returned to camp after a strenuous day walking over the survey, we sat down to a belated meal. Among other things was a platter of fried eggs. George took one, I took two, and Carlson upended the platter and slid the balance of the eggs onto his plate. He handed the platter to the cook and said, "Cook some eks."

Carlson's wrath was just as startling as his appetite when he had occasion to let go of it, and I was always careful not to get it pointed in my direction.

In 1919, two projects stand out in the season's accomplishments—the Addie-Copeland on the old Pend Oreille, Joe Fitzwater, supervisor; and the Elkhorn on the Beaverhead, John Somers, supervisor.

On the Addie-Copeland I made the survey, let small contracts to local crews for right-of-way clearing, and learned to smoke Old Missouri Corn Cake, vulgarly referred to as bridge sweepings. The grading was done by day

labor, and S.H. Ketcham was put in charge. Ketcham was another Bitterrooter. He, Cheatham, Williamson, and myself had worked there for the "Big Ditch." That was where we became acquainted. H.S. Lord was another engineer in the Bitterroot, and at one time in Hamilton he formed an engineering partnership with Cheatham and Ketcham. The name of the firm was, naturally, Lord, Ketcham and Cheatham.

I made the survey and plans for the Elkhorn, and as the job was estimated to cost about \$10,000 for approximately 2 miles of work, it was decided to let a contract. The work was formally advertised in the papers, and I was on hand in Dillon at the appointed time to open bids. Somers told me no bids had been submitted but that several wanted the job but wanted to go over the work with the engineer before submitting their bids, so we organized a party and two carloads of us went out. I was in a new Marmon that belonged to a cattleman by the name of Trask who was giving financial backing to one of the bidders. He said, "By God I've always owned the best team in the country and now I'll own the best car." Later I've listened to some wild tales about his experiences with that car, but fortunately the day we went out he had a young fellow for driver. Trask had a naturally reckless disposition and on top of this was pretty well "corned up" most of the time, which put a fine, keen edge to his natural recklessness. Finally one day later he turned the car over in the ditch, and just after he and his family had crawled out of the wreck, it caught fire and burned.

When we started back to Dillon after looking over the job, Trask said to the driver, "Don't let the damned Dutchman pass you." When we came to the little country store Polaris, we stopped for something and the "damned Dutchman" passed us. Later we caught up on a flat rocky bench. The road was just a single pair of tracks, but that didn't stop us from passing the other car. Just before this I looked at the speedometer, and we were going 60 mph. Now, in those days 30 or 40 mph was considered fast. I had never ridden that fast before, and at that time I didn't honestly think I ever would again, for I knew the other driver, but he let us pass, much to my everlasting relief. Later I thanked him for it, and he said, "If Mrs. Somers hadn't been in the car I wouldn't have." I said, "Thank heaven for Mrs. Somers."

After we returned to Dillon the bids were submitted, opened, and the contract let. The contractors were fine men, honest and conscientious, and determined to do a good job regardless of cost. We got along fine. They did a good job and made a little money. Ketcham was resident engineer.

In 1920, I made a trip on the Madison that I think was one of the most enjoyable and satisfactory trips I ever made. The reason for this was that it was nice country to travel in and I had Walt Derrick for a companion. Walt hired a car and driver in Sheridan for the trip. I don't remember the driver's name except that we called him Red. Why, I don't know, unless maybe it was because he had red hair. The car was a Nash.

We first went up the Ruby River to examine the route of the proposed Continental Divide road. I used speedometer readings for distance and took notes necessary for an estimate. There was an old wagon road of sorts as far as Three Forks. It was a fair country road to the Ruby Ranger Station, but beyond that it was hardly more than a scar on the landscape. I held my

breath in several places, and I like to think it helped. From Three Forks on we took to the sagebrush. Once in crossing a ravine, Red had to hit it pretty hard to avoid getting stuck and as a result broke the casting that held the steering post to the engine block. With this loose, the whole outfit headed off toward "Joneses" out of control. He got it stopped and tied it back in place with a piece of clothesline, and we limped on. That night we camped on the divide where there was a line fence, and Red got enough wire to replace the rope and make it more secure. We made the rest of the trip with the steering apparatus wired, and Red remarked with pardonable pride, "The darned thing is safer now than it was before." The next night we stayed at Henery's Lake, the following night at West Yellowstone, and the next day back to Sheridan. This trip also included reconnaissance surveys of the Targhee Pass and the Madison River Forest highways.

In June 1920, I was in Red Lodge with Supervisor Ferguson to meet with the county commissioners concerning a cooperative agreement. In the evening, "Fergy" suggested we go up to the courthouse where a group of ranchers and local people were having a meeting trying to organize an irrigation district and apparently were not having much success.

Dr. Siegfriedt, who was prominent in local affairs and did much to promote the Red Lodge-Cooke City highway, was there listening to the talks and discussion. Jealousy and neighborhood disputes were making it difficult to get anyplace. Finally the chairman turned to the doctor and asked him if he wouldn't say something. Doc stood up and very deliberately looked over the audience and gave forth with this pungent and eminently appropriate remark: "People who live in narrow canyons get narrow-minded." Whenever I have found myself or noticed anyone else becoming too hidebound on any subject, I think of that remark by Dr. Siegfriedt.

In the fall, we built the road to the Monture Ranger Station. It was on this job I first got acquainted with Bill White, one of the best construction foremen I have ever known. He was a native of the upper Blackfoot and an expert woodsman, but had had considerable experience working for contractors.

Bill was the type of fellow that, if you explained what you wanted done, could do it without a lot of stakes and plans to guide him. It was in 1924 while we were building the bridge across the Moyie River at Eileen that Bill had his leg crushed in an accident and spent the rest of the winter in a hospital. From that time on, he went downhill and later began drinking, and finally ended up a suicide in Priest River. The accident had left him a little crippled, and I think that was what was responsible. Bill was a fine fellow and did yeoman service for the Forest Service on road construction and on fires, and will always have a prominent place in my memories.

In 1921, we opened up the river bottom road from Honeysuckle to Leiberg. There was an old tote road there that forded the river. We improved this and built bridges to eliminate the fords. The bridges were flat stringer type on rock-filled crib piers and were built at an average cost of about \$8 per linear foot. George Duncan was in charge. The same year, we built the Seeley Lake road and the North Fork Flathead. This latter was a major project, and Carlson had the contract. Berney Kitt was resident engineer.

In 1922, the road from Cash Creek to the Bungalow was completed. This was a major job, and Carlson was the contractor. This was an 8-foot road and cost \$17,000 per mile. No comment offered.

During this season, I made two location surveys, one of the Continental Divide and the other for a logging railroad from Hayden Lake over Burns Summit. Before I went in on this job, I was talking one day with Koch and I asked him what the country was like. "Well," he said, "on the Hayden Lake slopes it's yellow pine type and open country." It was straight up. We fought Ceanothus brush from 3 to 10 feet high every foot of the way, most of it on 60- to 70-percent slopes. I thought I would lose most of the crew before we got through with it. We tried everything from a jack-knife to a mowing machine trying to find some instrument that would successfully combat that stuff. In more recent years on a trip to the coast, I saw a fine residence on the heights above Oakland where the grounds were being landscaped with the darned stuff. I told my wife, "There's a fellow whose education is a long way from being complete."

Neff, Bradner, and Tom Crossley were on the party most of the time, also R.H. Coulson, who at that time was on the Coeur d'Alene. L.H. Nelson, an engineer from the Regional Office, was instrument man and, while an experienced engineer, had apparently had no experience in the mountains. He got a scare one night that took all the vinegar out of him.

Our camp was near Burns Summit in a patch of heavy timber where the sun never hit. It was a dismal and gloomy spot. One night I woke up and heard slow, stealthy steps. They kept coming closer and closer until it was right by the head of my bed not more than a foot from my head. It sniffed at the edge of the canvas, and the hair on my head began to rise. Then it whined, and I knew what it was. Two hound dogs from down by the lake had been in camp for a while, then left, and I knew it was one of them come back.

Nelson slept in a small tent facing ours and only about 4 feet away, and he slept with the flaps of the tent open. We all slept on the ground. As I lay there thinking of the dog, I thought, "Wouldn't it be funny if that dog would walk in and lick Nelson in the face?" Then I went back to sleep. Some time later, Neff and I (we were sleeping together) were brought sitting up in bed wide awake by the most ungodly screech that I believe ever issued from human lips. Neff stuck his head out, and there was Nelson standing in front of the tent looking up the hill. "Big bear! Big Bear!" was all he could say, and we never could make him believe otherwise, and when a short time later he got a chance to go to Missoula, he lost no time in taking advantage of it. If anyone ever sees a lonely goat wandering the hills back of Hayden Lake browsing on Ceanothus brush, treat it kindly, for it belongs to Nelson.

In September while on a trip to the Beartooth, I made a reconnaissance survey for a road from Sage Creek over the ridge down Crooked Creek. To make the trip, we needed saddle stock, but as none were handy Supervisor Ferguson made arrangements with a rancher on Sage Creek to take us over by team. This old fellow was quite a character, and I enjoyed his conversation. One remark of his I have never forgotten. We had stopped for lunch well down on Crooked Creek, and from where we sat, we could see

beyond the Forest boundary and out into the flat Wyoming country. I turned to the old man and asked, "Is there any well-defined road from the Forest boundary on out to the county or State system?" He replied, "No, they ain't; you know them people down there are so damned contrary and ornery, they won't foller each other around long enough to make a set of tracks."

Glen Smith says that was not far from an accurate description of the situation in that area.

Nineteen-twenty-three was my jinx year. I went east on a trip, and the first thing that happened I got caught in a cloudburst near Silver north of Helena. Nothing happened, but it was mildly exciting for a while with water racing across the road in the low places almost deep enough to drown the engine, and I could see the roadbed melting out from under the Great Northern tracks just above me.

The second incident occurred on the Absaroka. Supervisor Shaw and I were walking up the trail in Yankee Jim Canyon when a rattlesnake reached out and tapped me on the boot; fortunately he didn't get through.

Then came the third strike and out. It was in the Bridger Mountains north of Bozeman on July 14. I was driving in to look over the Flathead Pass Forest highway route. Ranger Fred Ainger was with me. At one point the road gave way and down we went. Fred got dumped out first turn, but "Lizzie" and I went to the bottom of the hill. It has always been a debatable point as to whether the car or I got the worst pounding. I will say that after a spare wheel had been put on the car and it had been pulled back to the road by a team it came in under its own power, and that was more than I could do. But my troubles were not over. After I had spent a month in the hospital at Bozeman and quite some time in the office in Missoula, I attempted in the late fall to drive to Wallace where I was to meet Supervisor McHarg. It was on this trip that my jinx made another try for me. He didn't get me, but the experience left me weak and shaky.

It was late when I left Missoula and dark by the time I reached Saltese. The road over Lookout Pass was under construction but not open yet for travel, so I stayed on the old road up Randolph Creek. This road had grades up to 17 percent. The first steep pitch I hit I knew the car wasn't working right. I tried three times and gave up. I didn't like the idea of backing down that pitch in the dark. I got turned around finally and thought I would try the new grade. Fortunately, I was able to get through. Going down the other side I was very careful not to let the car get going too fast. About a mile down from the summit, something broke underneath when I pushed down on the brake, and the car started ahead with a rush. I reached for the emergency with one hand and swung the car into the bank with the other and was able to get it stopped and walked the rest of the way to Mullan, but thankful to be able to walk. The next morning the garage man brought the car in. He told me that either the bolts had not all been put in on the universal junction or they had not been tightened, for when it gave way he said only one bolt was holding it and that broke.

I have never been superstitious, but by this time I was beginning to wonder if I hadn't better carry a rabbit's foot and be a little careful. From 1924 to

1928, the work was more or less routine and nothing of special significance occurred. During this period, the Continental Divide road was built. Location surveys were made for logging railroads on the Coeur d'Alene in Big Creek and Eagle Creek. Location survey of the Dickensheet project was made in 1925 and lower Rock Creek in 1926. The Rock Creek road was built in the winter of 1926. Bill Neiland was foreman and K. Marlin assistant foreman. This was our first winter job. For equipment, we had a "30" cat and grader and a Fordson compressor that in a pinch would run two hammers. We had some 30-below weather that winter, but the work went well and when we finished in the spring had saved \$2,000 on the estimate. This also was some sort of a record.

Stockdale and I used to have a lot of friendly but warm discussions about my tendencies toward the use of tangents in my locations, and this matter was revived when he, Norcross, Thieme, and myself went over the Rock Creek job that spring. Stock said to me when we were riding over one of the long tangents, "Hartley, wouldn't it have been better to stay on the old road rather than use these long tangents?" I asked him why, and he said, "To take advantage of the clearing and any work that had been done on the old road." I told him then that the old road was nothing but a rut road and the clearing amounted to very little; also that in the new location, which was 12.5 miles long, at no place was it more than 50 yards from the old road, yet due to the better alignment the new location was just a half mile shorter. This meant, as I pointed out, a half mile less to build, a half mile less to maintain, and a half mile less to drive, and a saving in driving time and costs. Stock admitted we had something there.

While I admit my education is far from complete, I have learned that a straight line is the shortest distance between two points. Good workmanship in location and construction should not be regarded as inimical to economy if intelligently employed.

In the fall of 1927, we made the location for the Fishhook logging railroad. This was a tough job. Above the forks it was steep mountain work and below the forks we were working in ice-cold water most of the time.

Our first camp was at the mouth of Outlaw Creek. Then we moved to the forks, and the lower end was worked from the Avery Ranger Station.

On the crew were Jim Yule, Phil Neff, Clyde Webb, Ray Staniford, Lynn Thompson, E.W. Renshaw, and C.J. Kumler. Neff was there only a short time, but Webb stayed for the entire job and swung a lusty axe clearing line. Clyde never had much to say but always appeared to be doing a lot of thinking and that had me worried. I wondered what in the hell he was thinking.

There is a lot I could say about this job, but I must have some regard for the paper shortage.

In 1929, I attended a road conference at Santa Barbara, California. This was to be a study of equipment at a road camp back in the mountains, but when we got to Santa Barbara, it was raining and we couldn't get out so we held meetings in town until it stopped raining.

This was my first trip to California, and I debated some time whether or not I should take an overcoat, but finally decided to risk the wrath of the native sons and take it. It was fortunate I did so, for as it was I nearly froze to death. The incident may be taken as a tribute to the advertising power of California, but it was a near tragedy for me.

I have always been grateful that I was given the opportunity to attend this meeting. It gave me a closer insight into the problems of the other Regions and broadened my viewpoint. I also learned much about equipment. It was there I saw my first bulldozer. I had a chance to see it in action and study its performance. When I wrote my report on the conference, I suggested that we get one or two of these machines and try them out, but it was some time before this was done. I thought at the time how much one of those machines would have saved us on the Rock Creek job where we had a crew of 25 men working with pick and shovel.

Those attending the meeting as I remember were Norcross and Dort from Washington, Ress Phillips from Denver, Jim Mullen from Region 3, Blakeslee from Region 4, K.P. Cecil and Ted Flynn from Region 6, and of course Chester Jordan of Region 5.

We drove over roads built by Chester and, according to the gang, there wasn't a thing about those roads that was right. Chester was so busy explaining, and rather heatedly, too, at times, why we didn't put the road there instead of where he did or why he didn't use lighter curves and grades, etc., that it was some time before he discovered that he was being ribbed.

Out in camp, it was pretty chilly in the morning. Of course, that was duck soup for us, and we started making caustic remarks about sunny California. Then Jim Mullen found where a pane of glass had broken into long pointed slivers, and it didn't take his fertile brain long to conceive of a use for these. He poked them down through a crack in the wash bench and they looked exactly like icicles. In the morning Jim was waiting for Chester and gave him a shivery "good morning" and started talking about how cold it was and that he bet it froze ice last night. Chester scoffed at that, then Jim said, "Look there, if you don't believe it," and Chester looked and saw icicles hanging along the edge of the wash bench. He was dumbfounded. A little later, he discovered that he had been jobbed again. Chester had a hard time getting used to that bunch.

We were now about to enter the period of expansion in road construction and the advent of the machine age, bulldozers, cats and graders, compressors, etc. I will attempt no description of this work for I must taper off someplace or I will never get through with this writeup.

In 1931, Hornby started his fire plan study, and I began work on the fire transportation plan, starting first with the Clearwater in 1931 and the St. Joe in 1932 and following with a study for all the western Forests. There is much that might be said about this work, but most of this is a matter of record. It was highly interesting work, and I enjoyed every minute of it, but it had the unfortunate result of pulling me away from active participation in survey and construction during a period when radical changes were being effected. It was difficult later to get back in stride.

In 1933, the CCC arrived. That first year was a period of confusion and adjustment, what with Forest Service personnel striving to absorb new conceptions of work accomplishment with boys from the streets and alleys of New York and Brooklyn, the reactions of the boys, rudely transplanted hundreds of miles to a new life utterly foreign to anything they had ever known, and the administration of these boys by Army personnel. No wonder there was confusion when all these elements were suddenly thrown together.

A whole book could be written about the CCC, but one incident stands out in my memory, probably because it gave me a few bad moments.

I was on the Clearwater inspecting CCC work, and this particular morning was involved with the reconstruction of the road to the Bungalow. A rock cut had just been shot. All such work was of course worked on a schedule, and everybody knew in advance just when and for how long the road would be blocked, but some things don't wait on schedules and one of the boys in the North Fork camp chose that time to go off his head.

The dust had hardly settled before the ambulance with the boy and the doctor drove up. He walked across and explained the situation and wanted to know what could be done. My car was on the other side, so I told him to get the boy and I would take him to Pierce where he could get another ambulance. I was driving a Dodge panel body with a large door in the rear that could only be opened from the outside. I would have felt much more comfortable if there had been a heavy screen back of the seat, but we got to Pierce without difficulty and I left them at the Clearwater Hotel and went about my business. Some time later, I was driving past the hotel and the doctor came running out to tell me he couldn't get any kind of transportation and the boy was getting hard to handle, so I told him to get him and I would take him down. The doctor was very grateful for this. He put the boy in the car and started out. Everything went fine, but it was getting late in the day and the boy was getting more difficult. The doctor said that was the worst time of the day for him. When we started down the Greer hill I was nervous, for that is no place for monkey business, but we arrived in Orofino without trouble and took him to the courthouse where the sheriff let us put him in the bullpen until the car from Lewiston arrived.

The boy had a musical complex and kept talking about songs he had written and those he was going to write, and the doctor carried on a conversation with him continuously to keep his mind occupied.

Several days later, I saw the doctor at the camp and asked about the boy. He said, "Those yaps at the hospital at Lewiston didn't believe me when I said they should watch him closely, and he got away. They had quite a time finding him, and when they did, he was in the cemetery walking around holding up a stone cross and singing."

Before bringing my story to a close, I must say something about transportation conditions and difficulties in the earlier years.

The roads, and I am speaking of the main routes of travel across the State, were, to begin with, primitive routes of travel and remained so for quite a

number of years. These roads were narrow dirt roads with alignment and grades that were subject to the whims of the topography.

When I think back on those days and consider the kind of roads we had to drive over and the kind of cars we used, I wonder how we did it. For many years, I drove a Model T Ford and averaged from 6,000 to 8,000 miles per season, yet never had an accident aside from the one previously described, and the same was true of other Forest Service personnel. There were very few accidents, probably because we had to drive slowly. At that time, it took all day to drive from Missoula to Sandpoint or Coeur d'Alene, and it spoiled a day to drive to Helena or Butte.

Out of all of the road system, there were naturally a number of sections that on account of their dangerous or difficult features established widespread reputations. I will mention a few.

The Libby-Troy section. Here the road was narrow and contained some very sharp curves. The road climbed up to about 500 feet above the river. This road afforded a panoramic view of unsurpassed beauty of the Kootenai Valley for miles. It is unfortunate that this had to be sacrificed in the building of a modern highway.

The Laclede hill between Sandpoint and Priest River with grades up to 18 percent. The Tuscor hill on the south side of the river between Noxon and Trout Creek. This hill had steep grades and switchbacks. I drove over it one night without any lights.

Camel's Hump was another troublesome spot, and Priest Pass on the road to Helena was another that was widely known but not particularly bad.

Sullivan Hill between Helena and Great Falls was another notorious hill, famous principally on account of the adobe soil, and woe unto the car caught there during a wet spell. People living in that area used to take the fenders off the cars; otherwise the mud would ball up between the wheel and the fender and lock the wheel.

There were scores and scores of lesser hills and troublesome sections that used to make plenty of trouble for the Model T Ford, but the hills just mentioned stand out most vividly in my memory.

After I got a Ruxel gear installed, I had no fear of any hill. I believe a Ford with that gear would climb up the side of a house if it could get traction. I used to have a lot of fun passing big cars on the steep grades.

The old Model T was the butt of many jokes but did yeoman service and in many respects was a remarkable machine. There wasn't much about it to go wrong and when it did quit could generally be fixed in a few minutes with a screwdriver and a pair of pliers. Now we drive on paved highways in modern cars that are largely a mechanical mystery, and when they quit we must wait for the services of a skilled mechanic.

On our main road system in Montana, only one short section of the old original road remains. That is between Troy and the Yaak River, and this will be largely eliminated as soon as the new bridge is put in use, and thus

will pass the old road over which we traveled so many weary miles, where we saw the pioneer tourist, dust covered and weary, trying to make a steep hill or struggling to change a tire on a clincher rim or standing by the side of the road and asking in a bewildered sort of way how far it was to the next gas station. Again, he might be stuck in a mudhole and covered with mud and wrath, asking, "Why in hell don't Montana do something about their roads?" There was no answer.

Now we have a system of improved highways that, in spite of many faults, compare favorably with any State in the West, but the old pioneer tourist would resent being told of this for now he likes to sit in the sun someplace back East and tell his cronies about the time, years ago, when they bought a car and drove out to the West Coast and what a hell of a time they had crossing Montana and Idaho. He feels kinship to the covered wagons of the Oregon Trail, and in his own small circle feels heroic. Maybe he is.

My experience on fires has not been of a nature that merits detailed description. It was routine work—a dirty job that had to be done. I have met a few fellows that claimed they enjoyed fighting fire, but I have always thought there was something wrong with their heads. But in all this time, I have formed certain conclusions. I have always felt that the policy of fighting all fires in all places at all times was too inflexible. Many fires do more good than harm. I have been on fires where, considering the season of the year, the location of the fire, and the fuel type, for all the good we did we might just as well have taken the money represented by the cost of fighting the fire and put it in a sack along with a fair-sized rock and thrown it in the river. I have discussed these points with supervisors, deputy supervisors, and rangers, and they would invariably agree with me. I could never get an argument.

One man said, "What would the public say?" My reply was that if, after all the years of our administration of the National Forests, they didn't have sufficient confidence in us to say, "Those fellows know their business; if they say that is the right thing to do then it is the right thing to do," then someplace along the line we have "missed the boat."

I offer this not in a spirit of criticism but simply as a conclusion I have formed that years and experience have failed to break down.

It was either my good fortune or misfortune to be on many fires with Frank Jefferson. Frank was a great strategist and liked to shift his troops frequently, which was all right except it was pretty tough on the camp boss.

About 11 or 12 o'clock at night, Frank would come around with his plan, then about 4:00 a.m., I would have to get the crews up for breakfast, see that the trucks were lined up and ready, get the right number of men on the right trucks, see that they had tools, water bags, lunches, etc., and send them happily on their way.

On one fire, I was there 10 days and averaged 3 hours' sleep each day. It's a great life if you don't weaken.

Now I am bringing to a close this story that I thought at first would be short, but it has grown in spite of much that I have left out until it is nearly

a book. However, I have no desire to write or even attempt a book and be classed with a character in a story I read recently, about whom the author made the following statement: "He had a wild idea of writing a book. One of the delusions from which most people suffer is that other people are interested in their recollections."

My years with the Service have been rich in experience and lasting friendships; they have imbued me with respect for all the Service stands for and a deep affection for the hills and the forest and wildlife. In tribute to this, I would like to repeat a poem written several years ago by Mrs. Bessie K. Monroe of Hamilton, Montana. The title is *Meadows*.

"I have known a mountain meadow,
All sweet with highland flowers,
Where the deep grass drank the sunlight
In the quiet forest hours.
I have rested in camp at night time
Near to the singing stream,
Glad for the end of the rock-bound trail,
Glad for the camp fire's gleam.

"I have come far from the meadow
With its lovely highland flowers,
God's garden of the skyline,
Tended by sun and stars.
Sometimes Life's trails have been rock-bound
And wearying to the heart,
But I know of soul-lighted meadows
Where God plays the gardener's part.

"There friends are the flowers that gladden
And love is the singing stream;
The lowly lights of service
Are like to the camp fire's gleam.

"Oh, I shall break camp with the daylight
And climb again to the trail,
But my heart will keep to the meadow—
I seek no distant grail.
The treasured flowers of the highland
Will ever in memory blow,
And the hearts of love and service smile
From the meadows that I know."

/s/ H.A. Calkins

Communicating the Hard Way

Fleming K. (Red) Stewart

My youngest grandson has often asked me, "How did you do it in your time?" Well, this is how we once tried to do it "in my time."

In these modern times of orbiting communicating satellites, two-way walkie-talkies, direct distant dialings, conference callings, and many other modern means of communication, it may be interesting to some of our young Forest Service people and maybe some not so young how we once tried to communicate many years ago.

In the summer of 1915, I was employed as a fire lookout on Mallard Peak on the Clearwater Forest near the southern boundary of the St. Joe Forest. That was the first year and, insofar as my knowledge is concerned, the only year in which the Forest Service, at least Region 1, employed that invention of the devil known as the heliograph. The heliograph was a communicating device, much used by the army in its campaigns against the plains Indians. Some enterprising genius along about my era had a real brainstorm and came up with the idea that the heliograph would be a good communication media to supplement the woefully inadequate Forest Service telephone line systems for fire-reporting purposes. In the early winter of 1914 and 1915, forestry students of the University of Montana (the first regular forestry class of 1914) were interviewed as to our aptitude in the use of the heliograph. Well, we passed the course—not because we were proficient, but more because, as I recall, there were only four of us to be interviewed. We were promised jobs as fire lookouts effective July 15, 1915, and were instructed to learn the Morse Code and to become proficient in its use.

My assignment was Mallard Peak. This bare rock heap had been occupied as a lookout only the year before. It was totally undeveloped. The trail leading to it was little more than a game trail and barely passable. The map board was a wooden post wedged into the rocks with a wooden box top nailed to it. The heliograph was my sole means of communication.

As I have said, the heliograph was an invention of the devil. The contrivance, mounted on tripods, had a mirror and shutter arrangement designed to enable the operator and receiver to send and receive messages in Morse Code. Well, as Norman Mailer, the modern four-letter-word user would say, "Oh! dear"—you just couldn't do it.

For instance, if the day was cloudy, you couldn't operate, and a partly cloudy day pretty well stopped you too. We amateurs weren't any great shakes as operators. This is how the gadget worked. You aimed the machines at your object and adjusted the mirrors to get the proper sun

reflection. Then, with the shutter, you sent flashes and hoped that the other guy would be alert enough to see and acknowledge. Then you would proceed to transmit your message. In about 2 minutes, you could almost bet that your receiver would interrupt your transmission with the universal signal that either you were out of focus (the sun left you or was behind a cloud) or that you were using your own code instead of Morse.

So it went. I tried sending messages to Pot Mountain, many miles to the south, to Elk Prairie 20 to 30 miles to the north, and to Pole Mountain about 13 miles to the north. Only Pole Mountain responded with any degree of satisfaction.

The summer rocked along without much lightning. However, in late August we had some, and I had a fire to report on the St. Joe. So, okay—the trusty heliograph! After several attempts, I finally alerted Whitey on Pole Mountain. I began “Fire on—.” Whitey interrupted—flash-flash—“Out of focus.” I began again. “Fire—”; by then cloud cover. Then a few more attempts to transmit. As far as I ever got was “Fire on the north slope of—“ before the cloud intervened and shut off all transmission. I said, “To hell with it,” and took off to deliver the message in person 13 miles away. The above attempted correspondence took at least 1 hour. Anyway, I was damn sick of living alone at Mallard Peak and wanted the companionship of the lumberjacks at Pole Mountain where they had a real cook. Pole Mountain then was a St. Joe summer ranger station and was connected to Avery by a sometimes working phone line. Those heliographs—well, as far as I was ever to know their use in 1915 was an utter failure. I never heard of them being used again—and believe me, I never recommended it.

Now, I understand Region 1 has found a contraption of some kind—a contrivance of tripods and mirrors. They asked me what I thought it was, and I told them it was one of those damned old heliographs and that they should throw it on the dump. Seems like they wanted to send it to the Chief as a museum piece, though.

(For a description of the heliograph and its use, refer to an old Signal Corps manual.)

One of the greatest handicaps to the early day Forest Ranger was lack of a communication system. Up to 1910, there was no means of transmitting messages faster than by saddle horse. This lack of communication was such a handicap in fire suppression during 1910 that the Forest Service embarked on a telephone line construction program. It also equipped lookouts and stations with heliographs.

The heliograph was an instrument for conveying messages by code using mirrors and a shutter to flash rays from the sun. It was not very effective for Forest Service work because of its limitations: It could not be used at night; cloudy weather made it inoperable; many men were not patient enough to learn the code; it took a lot of time to send a message; the instrument had to be reoriented almost continuously due to the Earth's rotation; it could not penetrate smoke or haze.

The Forest Service, recognizing these handicaps, set out to establish a telephone system that would link every lookout and ranger station. By

1915, there was a telephone line to every ranger station and a few lookouts. The Fish Lake and Chamberlain Meadows Stations were connected through to Montana only. The line along the Lolo Trail reached Indian Grave.

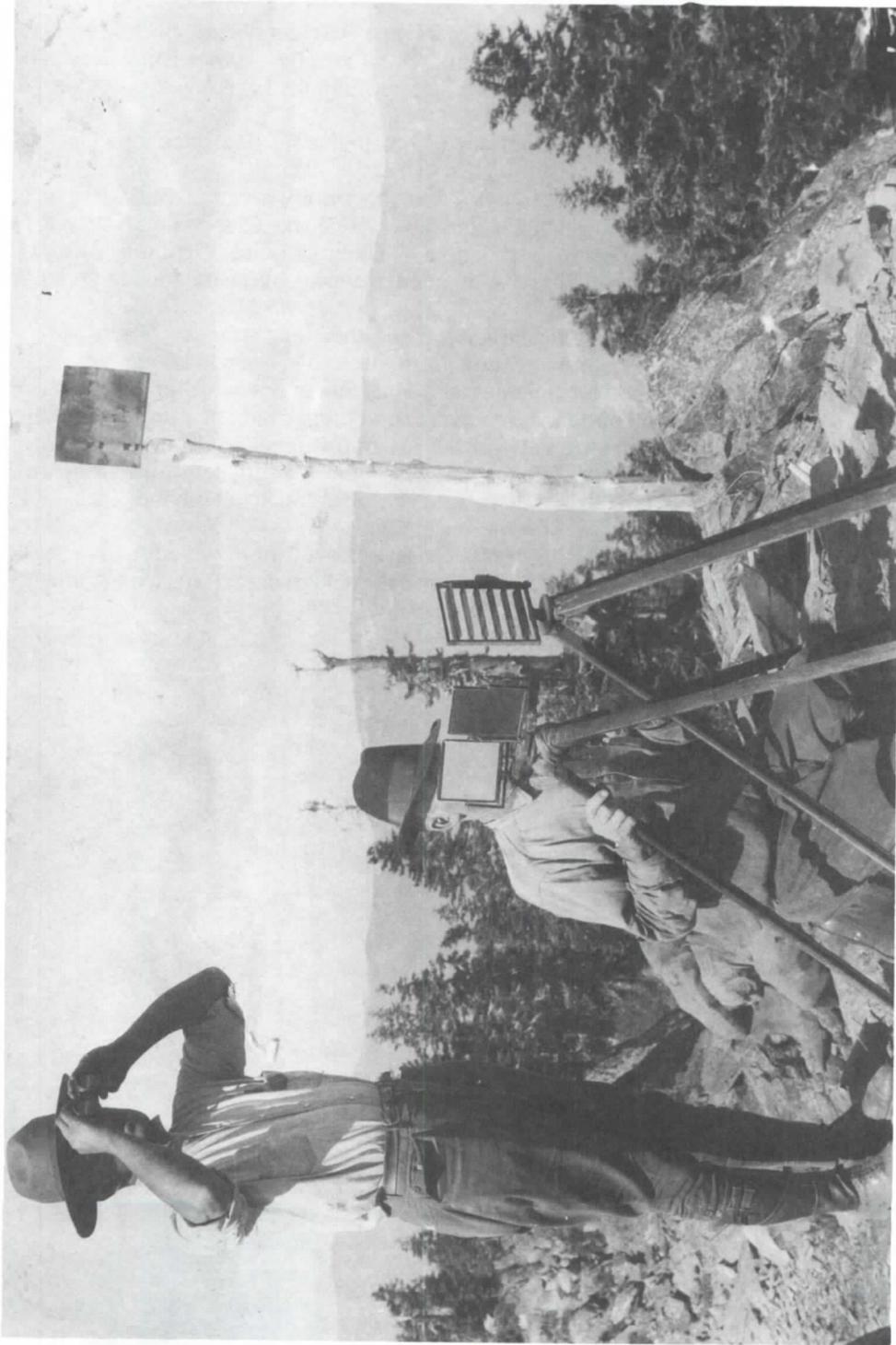
In 1916, the Chamberlain Meadows line was connected over Fly Hill and to the Bungalow-Cook Mountain line about 6 miles above Bungalow. The line to Fish Lake was extended to Moose Mountain Lookout.

By 1917, almost all lookouts in use at that time had telephone lines.

The increased use of telephones and the smoky weather of 1919 put an end to heliographs on the Clearwater. By 1933, the Clearwater National Forest had 640 miles of telephone lines and plans to build 170 more miles. However, it appears that this year marked the peak mileage for telephone lines.

In 1933, the first practical radios made their appearance. These sets were chiefly used for communication from fires to ranger headquarters. These radios were rather temperamental. Ham operators were picked and trained to keep them in operation. However, the radios gradually improved and slowly replaced the telephone network. This transition was so slow that the telephone lines gradually fell into disuse without being removed from the ground. The Forest is still picking up abandoned telephone lines.

After World War II, the Forest Service moved more rapidly in using radios. The present communication plan for the Clearwater Forest contemplates the use of about 60 miles of telephone lines.



Cook Mountain District Ranger James C. Urquhart atop a peak in 1917 with a Forest Service heliograph

Historical Sketch of Experience With the USDA Forest Service

J.C. Dort

I was tapped for work with the USDA Forest Service in the spring of 1916 to have field charge of a Flood Runoff Study in Los Angeles County. Six years' experience in the Water Resources Branch, U.S. Geological Survey, had prepared me for this job.

On reporting for duty in Los Angeles, California, I found that Mr. F.H. Fowler, District Engineer, Forest Service, had worked up a cooperative project for this study, with Los Angeles County putting up most of the money, the Water Resources Branch, USGS, furnishing a qualified engineer, and the Forest Service undertaking general supervision.

Severe and damaging floods, originating in the Angeles National Forest, persuaded the county supervisors that some form of flood control was needed. Mr. Fowler persuaded them that the first thing was to get some records of flood flows as a basis for planning such control work.

My job was to install streamflow recording stations on all the important streams debouching from the Forest and accumulate flow records. The stations were duly installed, and we operated approximately as planned. But after about a year it was decided that USGS would be happier to assign a new engineer to this project, and I was transferred in April 1917 to the San Francisco office to the position of Assistant District Engineer.

Here I found that the Division of Engineering was a service organization and ready to take on any jobs of an engineering nature. At that time, this was principally the processing of rights-of-way applications for hydroelectric developments and electric power transmission lines on the National Forests in District 5 as it was known at that time. We had a drafting force of five or six or more who were kept busy on forest maps and miscellaneous jobs, one of which I recall was the preparation of a lot of flight maps for the Army Air Force.

The First World War had engulfed us by this time and with almost no experience for me, Mr. Fowler, whose father was an Army officer, took leave of absence for Army service. The bottom almost dropped out for me, but with help from C.S. Brothers of the Division of Lands who was highly experienced in rights-of-way matters and a wonderful clerk in Margaret Fulham, I managed to make out til the war was over and Mr. Fowler returned.

Then money was appropriated for roads and trails, including bridges. This gave us an opportunity to begin to cash in on our engineering training. We

worked out plans for systems of Forest Development Roads on all the National Forests in District 5 and the design and construction of a number of substantial road and trail bridges. We had a good many problems, but managed to work things out. One of the first projects was a suspension bridge located some 12 miles from the end of transportation. Here timber was readily available for the towers and for the stiffening truss; it was whipsawed right on the job. Then we worked up designs for suspension bridges using galvanized steel towers and stiffening trusses in sections of such lengths and weights that they could be packed into the bridge sites.

In the spring of 1921, I was selected for detail to Region 8, later designated Region 10, in southwestern Alaska to make a water power survey at a number of locations known to have good power potentials. Most of southeastern Alaska was within the Tongass National Forest and its timber resources were quite well known, but since large quantities of power would be needed to convert the timber into newsprint or other useful products, more information was necessary. The need for good streamflow records had been anticipated so there was a quantity of good data collected by the Water Resources Branch of the U.S. Geological Survey in cooperation with the Forest Service. I reported to B. Frank Heintzleman, Assistant Regional Forester, who was to have administrative supervision of this power survey at Ketchikan and headquarters of the Tongass National Forest. Here they had docks, a warehouse, and across the channel was their boat yard and repair shop. I should say here that all transportation outside of the towns was by boat and the Region had quite a fleet, including the Tahn, a 65-foot cruiser as flagship with sleeping accommodations for eight or more and some five ranger boats of 30-35 feet. Fortunately, I had had considerable experience around water, small boats, canoes, etc., so I felt very much at home with my assignment. The Tahn, with Captain Aiken and a cook, was home for the season. A survey crew of three were all ready to go to work. Commenting on the setup, F.H. Fowler said, once upon a time, that I was born with a silver spoon in my mouth, and about that time I think it was E.E. Carter, Assistant Forester, who said that up to that time, I had latched on to one of the best jobs in the Service.

It was all quite a job,¹ for the most part extremely interesting, a lot of hard work, then some days when storms made field work impracticable, some narrow escapes and all done in a region of magnificent and some of it almost breathtaking scenery.

I returned to regular engineering activities in Region 5 in the summer of 1923 after completing the manuscript for my Alaska report in Washington, D.C. Then at the end of the year, I was transferred back to Washington as Regional Engineer for Region 7. Here at first, the big job was surveying all the tracts of land being purchased for National Forests in the Eastern States. Fortunately, there was R.E. Pidgeon, an experienced land surveyor in the office, who knew this part of the job extremely well.

¹ Details and results of this survey are covered in "Report to the Federal Power Commission on the Water Powers of Southeastern Alaska."

The Forest road and trail share of the program had not been stressed in Region 7 to this time and we had to make up Forest plans the first thing. Fortunately, there was a small accumulation of road funds, and we were able to get quite a few projects going by the summer of 1924.

At that time, the Region extended from Maine to Florida and from Virginia to Oklahoma. With a large land purchase program with CCC funds, the Region was divided in 1935, with Virginia, West Virginia, and Kentucky remaining in 7 and with the other southern States being designated as Region 8.

In the early years, with a little encouragement, Pidgeon took an engineering course at George Washington University and got his B.S. degree in civil engineering. Being in Washington, D.C., the University planned its courses so that Government employees could take work there after office hours. When Region 7 was split in 1935, R.E. Pidgeon went to Atlanta as their Regional Engineer.

Early in the depression, emergency road funds were appropriated to help relieve the unemployment situation. We were advised of the funds that would probably be available to the Region, so we planned helpful projects and even solicited bids for some heavy equipment to be ready when we received the go signal. The funds were allotted under existing instructions and regulations so we were able to put men to work under 2 weeks of the signing of the legislation. This was the beginning of an expanded Engineering program that lasted until the late forties, with a short slow period during the Second World War.

The peak period came with the CCC (Civilian Conservation Corps), when with over 200 camps in the Region, the Engineering staff expanded to over 50. We built several small concrete dams, a lot of concrete and steel bridges, and miles and miles of roads and trails of varying standards. At one location where we had to make a 20-acre lake for a recreational project, an earth dam seemed to best fit the site. Following new methods and techniques in earth dam construction, we went ahead with some informal cooperation with the soils engineering section of the Bureau of Public Roads. Suitable soils were located within the reservoir area with proper clay content, and moisture was carefully controlled during the rolling with heavy sheepsfoot rollers. In the beginning, people living downstream were quite fearful, but when they saw the substantial character of construction, they lost all their reservations.

The Region purchased many large and small tracts of land so that land surveys under Marshall Wright became an important part of the job. We were able to use aerial photos for several Forest maps and by laying out on metal-mounted sheets very accurately the survey data, we were able to compute tract acreages well within the allowable error.

During this peak period, we took on an architect who had plenty of work drawing plans and specifications for ranger stations, equipment depots, and his big job was to make house plans for a small settlement on the Cumberland National Forest in Kentucky; some 40-50 units were involved.

The foregoing is a brief sketch of my engineering experience in the Forest Service from 1916 to my retirement in 1948. It was a splendid organization in total, as well as the Engineering section. I especially enjoyed working under F.H. Fowler, who was a sympathetic and understanding "boss" and a very well-qualified engineer. While reporting direct to the Regional Forester, nevertheless, I had considerable contact with Chief Engineer T.W. Norcross. He was a fine engineer, and I had many splendid field trips with him. He was a very friendly person.



District 7 personnel, March 1924. (From left, top row: W.W. Ashe, R.M. Evans, H.O. Stabler, J.C. Dort. Middle row: Miss Pote, Miss Coles, J.E. Scott, M.E. Fagan, F.W. Reed, C.G. Smith, M.B. Stickley, Mrs. Smoot. Front row: Mrs. Owen, Miss Ellis, Miss Holcombe, Mrs. Snyder, Mrs. Burnham, Mrs. Greenley, Mrs. Deadrick, Miss Anderson, Mrs. Murray, Miss Hoffman.)

History of Engineering: James L. Brownlee

Mrs. James L. Brownlee

James L. Brownlee worked for the War Department for a decade before joining the staff of the Forest Service, first with the Army Engineers, constructing dams on the Allegheny and Ohio Rivers. Later for 6 1/2 years, he worked on the Dalles-Celilo Canal along the Columbia River. Obstacles such as solid rock and many falls and rapids had to be overcome so that boats could travel on the river. Jobs slacked off because of World War I, and he went back to college and earned a degree in mechanical engineering and had about 6 hours to complete to finish electrical engineering.

In the early fall of 1917, he received a call from the Forest Products Laboratory at Madison, Wisconsin; he was requested to report for duty immediately. Here he became a dry kiln expert and was sent throughout the country to inspect "Thiener Dry Kilns" wherever they were installed in lumber companies, which used to dry lumber for the Government to build wagons, airplanes, and gun stocks, needed very badly for the war effort. As soon as the war was over, he was transferred to Region 2, stationed in Denver, Colorado (during May 1919), in charge of the Division of Engineering as assistant. The Division consisted of five States: Wyoming, Colorado, North and South Dakota, and Oklahoma. He designed, supervised, and constructed many worthwhile projects that covered a wide area.

As soon as weather permitted, he would be out in the Forest, in some area, laying out sights for roads or trails. (There were few roads at this time.) He would carry a bedroll, briefcase, a handgrip with toilet articles, camera over the shoulder, and sometimes a suitcase. Usually he and anyone with him would eat and spend the night at Ranger Stations or ranch houses. Sites for dams were laid out similarly. Obviously, he was out in the field most of the late spring, summer, and fall.

It was not an easy life living and hiking in the wilds in all sorts of weather, and being exposed to various insects and the like. The few roads existing bore no resemblance to our modern highways; they were narrow and rough and wound around a mountain. He would have to travel along them to get into backcountry to inspect bridges under construction. On occasion, they used packhorses or rode in a Model T Ford; often one man steered while the other pushed up the hill. He has said he pushed many a Ford uphill. The curves on these shelf roads were often blind, and the driver would have to keep honking to warn anyone coming from the other side because one car would have to back into an available wide spot to give the other room to pass. He also traveled in a spring wagon to reach a certain destination.

One of the early roads he constructed was the Squirrel Creek Road on the San Isabel National Forest. The camp for workers consisted of tents. A large tent housed the office and a huge one the kitchen and mess hall. Part of the road went through rock, so that workers would have to blast much of it with charges of dynamite. Whenever they shot off such a charge, everyone was warned to leave camp and go out some distance and stand behind trees. When the charge was fired, they would yell "Fire, Fire," and parts of trees would fly by in assorted sizes to the accompaniment of a noisy "Boom." Once on this job, a party of school teachers wished to see such a charge set off. Mr. Brownlee found an overhang on a cliff opposite where a blast was to be set off. They were perfectly safe in their ringside seats, but lost any enthusiasm they might have had on seeing rocks, boulders, and debris erupt upwards to the accompaniment of thundering explosions.

On another occasion he supervised the building of a water tank above the nursery at Monument, Colorado. This job took a good part of a summer. Hardly a day went by that some man did not kill a rattlesnake or so.

Much of another summer was spent under the towering beauty of the Spanish Peaks in Colorado building a road up to a recently completed community house. It was not unusual to see bear, mountain lion, and bobcat tracks in the dirt around the camp and along the road itself. At night, they could hear the cats snarling and climbing on the screens of the cabin housing the meat and supplies.

A dedication ceremony was planned for the community house on a Sunday after the road was completed. Many business leaders and officials were invited for the ceremonies, which included a barbecue luncheon featuring beef and pork on buns and hot coffee. Several cooks were hired to prepare the food. They dug large pits in which they cooked the meat in an open clearing between the end of the road and the community house. They kept the fires burning and basted the meat with sauce throughout the night, taking turns sleeping. One of them dropped off to sleep for a few minutes and awoke to find a ring of eyes watching him. Needless to say, he was frightened and quickly built up the fire. The day of the dedication was quite rainy, and the cars could not negotiate the grade of the road, which climbed upwards all the way and, being dirt, was quite slippery. Many of those invited did not attempt the trip, but those who did had to leave their cars below the last steep hill and walk up to the community house. The rain continued to fall all day so that there was a plenitude of barbecued meat and coffee.

He spent most of another summer at Ward, Colorado, staying at the hotel while he built a reservoir. Every morning about 3:00 a.m., the outdoor toilets were busy places because the water, which was outstandingly refreshing, contained minerals with a cramping and laxative effect. He laid out the road site between Ward and Brainard Lake, designed and built a dam and a bridge. At one end of the lake, he built a fish ladder in the structure. Many scoffed and laughed at the fish ladder idea until they saw the trout in it.

Many of the rangers' homes were designed by him. He said that the Government could not expect a college-trained ranger to be willing to have his family live in a shack under primitive conditions in the wilds. Attractive



*Fish ladder designed by J.L. Brownlee,
Brainard Lake, Colorado, circa 1935.*

homes were built out in Forests (getting away from the two-room shack), incorporating the comforts of the city.

On a trip through Arizona, he observed the construction of an air conditioner in a cottage court we occupied. He used this design in rangers' homes in Oklahoma. More than one ranger was pleasantly surprised by such an unexpected luxury.

He employed a versatility of design in his dams. In the Black Hills of South Dakota, he designed a huge earthen dam. Some people not engaged in the engineering profession doubted if dirt could hold back a wall of water. They did not realize how the dirt would be dumped, smoothed out by tractors, watered down, and further packed by machinery, foot by foot. When completed, the dam provided a popular and widely used recreational facility for the Region.

On a vacation spent in Oregon where he visited the famous Timberline Lodge on Mt. Hood, he was sold on possibilities for such buildings as recreational facilities in the Rocky Mountain Region. He tried to promote

one for the area in southern Colorado out of Pueblo on the St. Charles River, where he had designed and built a dam that provided that area with camping facilities, boating, and fishing. Since the area was easily accessible for a large Region, he felt that a lodge there would be well used. Another dam out of Glenwood Springs near Meredith, Colorado, was also for a recreation area affording camping and fishing.

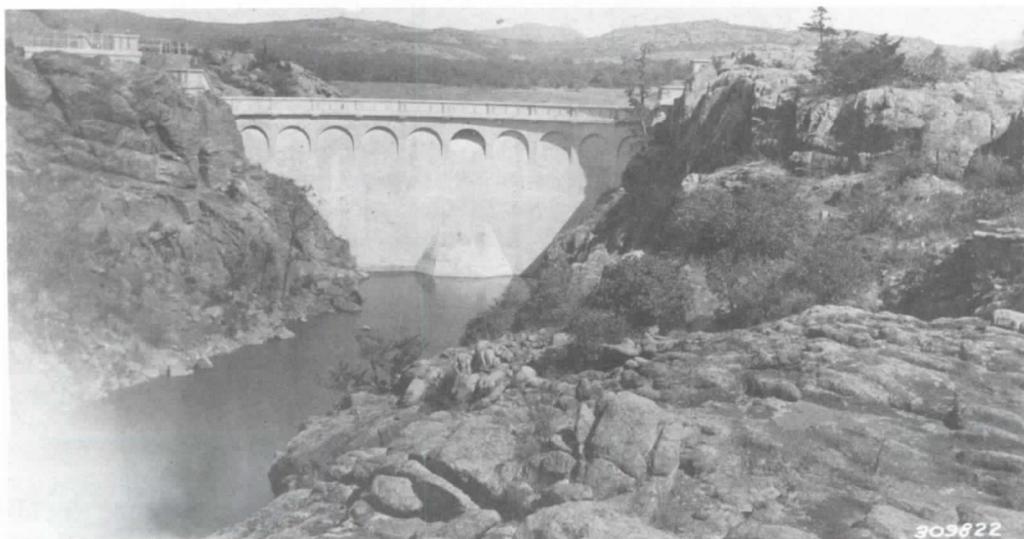
Traveling and staying in back areas as he did, he would run into many regional peculiarities. In southwestern Colorado on one occasion, he stayed at ranch homes where one of the family who had died during the winter would be buried under the snow in a pine box at the back awaiting the milder weather of spring when they could dig a grave and hold the funeral. One road he often inspected lay just below a cemetery that covered a sloping hillside. Sometimes graves were dug too shallow, and anyone passing along the road below would be assailed by a sickeningly sweet fetid odor.

Must give you a few tales while he was working out from the Forest Products Laboratory. He was sent to Wilson, North Carolina, to help the Hackney Wagon Company. They told him all about a Major Bosse and to look out for him, that he always wore a big army overcoat with a cape. Some man got off the train just ahead of him who he decided was the Major. He went to the hotel and left his grips and asked how to find the Hackney Wagon Company, and went right down and decided that *was* the major as he and Mr. Hackney were saying, "Thienre Dry Kilns were a failure, etc." The clerk was answering the phone, and he sat down. Then she came to him and said, "By chance, are you Mr. Brownlee?" He said, "Yes, by chance I am Mr. Brownlee." She had to laugh, but hurriedly closed the inner door when he got out to where the dry kiln was located. He asked how they were coming along. Young Hackney said, "Oh fine! See, I have perfect circles." Mr. B. looked and said that it wasn't even working. If it was, they wouldn't be getting any perfect circles, and then he asked if they had a pile driver working. They said, "No, that's the pump." He walked over, put his hand on it and the pounding stopped. They said, "What did you do?" "Oh, just adjusted it a little." They were all quite surprised that they would not have had any pump soon.

Hackney Sr. would sit back on some logs and watch the saw work. Mr. B. said, "You want to keep him out of there as sometimes the saw will hit a knot and some of the teeth will fly out and if they strike him, it will kill him." When Mr. B. came to work several days later, they said, "Well, *it* happened. The saw struck on a knot and the flying teeth struck just where he had always sat." He became acquainted with another man there who asked him to come to his home some evening, and while there, he opened a trunk and it was just filled with confederate money. He asked him what he was going to do with it. He replied, "Oh, it will all come back," and really believed it. The Hackney Wagon Company flew the American flag and below that a sort of a blue flag. Mr. B. asked them what that flag was. The Sr. said, "That's our bonnie blue flag." Mr. B. said, "What's that flying for?" He said, "Oh, it will wave instead of the other again." (They died a hard death, or did they ever die?) They often discussed the dry kilns, and when the Sr. became excited, he would take his cud of tobacco out of his mouth and work it over with his fingers and then put it into his mouth again.



Lower West Cache Creek Cultural Project Dam No. 2, flood, May 1935.



Quannah Creek Dam, Wichita, September 30, 1935.

The Regional Office occupied the entire third floor of the Post Office. Col. Peck was Regional Forester. Mr. B. worked there usually Saturday p.m., as well as Sunday in order to accomplish some work. Off from his office was a long drafting room of which he was in charge. He had an assistant in his office. His secretary had an office (at times there were two). Three doors led into his office, and people would be coming through these and the telephones would all be ringing. He was interested in aerial mapping, which was an innovation in the thirties. Region 2, of which he was in charge, was all mapped in this fashion, and various earlier inaccuracies were discovered.

Historical Recollections of Engineering Work in the USDA Forest Service

Clifford Allen Betts

The call of the forests, the urge to hunt and fish, and the love of nature seem to be inherited from many preceding generations by some men. Many of the dedicated USDA Forest Service workers are such men. Woods work comes naturally, and they feel at home working in the forests. They become conservation conscious and, the way these United States are growing, it is fortunate for the 181 million acres of our 154 National Forests that they are. This common interest in conservation makes for a rare esprit de corps with no clock watchers.

Into this elite Forest Service family I had the good fortune to be initiated in January 1919 at the Denver headquarters of Region 2, which, at that time, included the Lake States of Wisconsin, Michigan, and Minnesota. It was as natural as "falling off a log," as I had just come from the virgin spruce, fir, and hemlock forests of the Pacific Northwest where, as chief engineer on the construction of an aircraft spruce production sawmill of 125,000 F.B.M. daily capacity that was built by the 135th Squadron to provide needed spruce for planes for World War I, I had become forest minded.

In Colorado, there were forest maps to be made of the Uncompahgre, Cochetopa, Pike, and other Forests, engineering work on the "Million Dollar Highway" between Silverton and Ouray, as well as the Buffalo-Tensleep road in Wyoming. Res Philips, who supervised much of the engineering, is now 92. The Regional Forester, Allen Peck, 1920-1940, will long be remembered in Denver for his farsighted cooperation with the City, State, and civic groups in fostering worthwhile developments where the Forest Service was involved. It was at this time the familiar pine tree shield, so long the emblem of the Forest Service, was designed by Charlie Gosom in our map making department. What a time he had putting "Department of Agriculture" on the little badge. Now, the Multiple Use emblem is replacing the old pine tree.

In those days, the pay scale for the U.S. Government was based on 30-year-old laws, so, when the Denver Water Board offered me double what the Forest Service was paying to work on the transmountain water diversions from the Fraser, Williams Fork, and Blue Rivers of the Western Slope, I had to think of our young family and accept. This later led to engineering on the 6-mile Moffat Railroad and Water Tunnel and after that to a 7-year engagement with the U.S. Bureau of Reclamation on the 450-foot Owyhee Dam in Oregon, the highest prior to Hoover Dam. There was also a 3-mile and a 4-mile tunnel on the Owyhee Project.



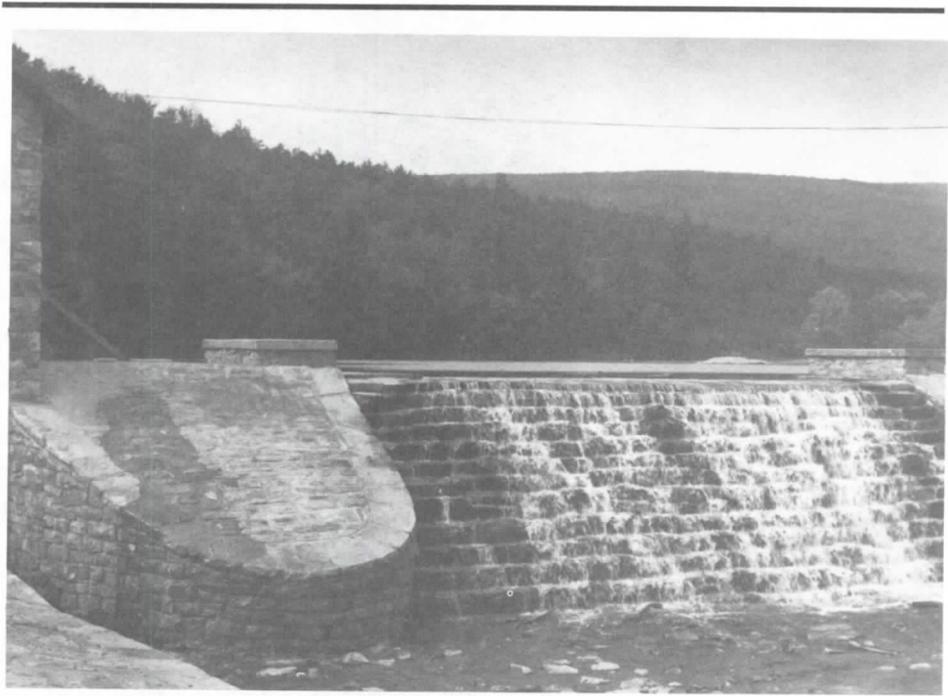
Sherando Dam, Lake, and Recreation Building, George Washington National Forest, Virginia.

When, in 1934, the Forest Service was called on to handle design and construction of dams, roads, bridges, buildings, and other improvements by the Civilian Conservation Corps in National and State Forests, I was invited to rejoin the Forest Service in Region 7, Regional Office in Washington, D.C., and was subsequently promoted to the Washington Office (Washington Headquarters Office of the Forest Service) in the Water Resources Department of Engineering.

Altogether, some 100 dams were designed and built under my supervision, and I have had the pleasure, years later, of seeing thousands of people enjoying the water recreation created at such dams as Cowan's Gap, Pennsylvania, Sherando, Virginia, etc.

Great care was taken to give maximum safety at minimum expenditure. Hydrologic studies were made of potential streamflow, tests were made on soils and concrete, models were used where needed, and construction was inspected.

At Cherry Plains Dam, the New York State Government exerted considerable pressure to reduce expenditure by cutting down the spillway size as the concrete was the larger part of the cost of that earth dam. Of course no concessions were allowed by the Forest Service and, just as the construction was completed, an unprecedented rainstorm filled the spillway to capacity, proving that a smaller waterway would have caused the destruction of the earth fill dam. No more complaints were ever heard from Albany.



Greenwood Furnace Dam, Pennsylvania, 1938.

In the West Virginia mountains, farms have been divided among growing families until the resulting farms were too small to support a family. Furthermore, the predatory hound dogs and cats have decimated the one plentiful game supply. Poverty results. As a ranger was driving me to a dam site past a forlorn shack with broken front steps on which a ragged girl was pensively sitting with elbows on knees and chin in hands, he told me that the last time he passed there he ran over a rooster. Realizing that the poor family couldn't afford a loss, he hastened back with the dead bird to pay for it. The girl said, "Shucks, if he can't get out of the way of a Ford, he can't catch up with the hens nohow." Anyway, he paid double as a good Forester would.

In the Blue Ridge Mountains of Virginia, near a fire lookout tower on the George Washington Forest, I found a mountain man with 26 children. He had a large covered cellar for apples, potatoes, turnips, and other food, also a few goats and the usual hound dogs for hunting. Call it multiple use of the Forest by a single family if you like.

Over on the Monongahela National Forest in West Virginia, the Supervisor, Arthur Wood, who had lived in the Elkins area all his life and knew everybody, was one of the few exceptions to the usual Forest Service practice of shifting field personnel from one area to another as a training and broadening policy. Whenever he was caught away from home at mealtime, he would just stop in at a friend's cabin. We did this one day, but the pipe-smoking mountain woman met us without the usual smile. When her husband showed up with his gun, hound dog, and a couple of rabbits, the

cause of her peeve became evident. Taking her pipe out of her mouth she yelled at him, "Why didn't you fetch me some firewood for dinner before traipsing off?" "Oh, I thought the kids would do it," says Sam, trying to make a joke. There were no kids. She scowled and said, "Sam'l, if you were half as good a man as I am woman, there'd be something besides hound dogs running around this cabin."

By 1935, the time had gone by on the Forest when, if you asked the ranger where the toilet was, he would just wave his arm toward the woods and say, "There's a thousand acres of it, help yourself."

The 1930's was a period of transition from timber management and grazing to "sustained yield and multiple use," whereby all Forest resources, water, wood, forage, wildlife, and recreation are managed to field the maximum volume and variety of benefits to the maximum number of people while fitting the uses into each other and giving priority to the most valuable. Under this plan, the 181 million acres of National Forest lands, which bring in cash receipts of over 125 million dollars a year, will be producing valuable water, timber, grazing, hunting, fishing, and recreation concurrently, although a few areas may be used primarily for their most valuable resource.

As the number of Forest visitors per year passes the 24,000,000-per-year mark, I daresay that, with the population explosion and easy access by auto, the number of users will increase "by leaps and bounds."

Engineering was vital to the success of the Forest Service and always will be. In fact it is obvious that 150,000 miles of National Forest roads with appurtenant bridges, signs, surveys, and trails present a growing engineering challenge. This problem was being felt and met after World War I by the utilization of soil mechanics, drainage, grade, and curvature design to meet the requirements of heavier and faster automotive traffic, relocation using aerial surveys, and utilization of the discoveries of the Highway Research Board (with which Forest road engineers have always worked closely). Few people realize how much engineering know-how has gone into the Forest Service roads.

For example, the ubiquitous bulldozer was invented on one of the National Forests of the Northwest. In order to spread road material cheaply, a heavy blade was attached to the front of a tractor, and it spread gravel so well that it was given to a tractor manufacturer to produce and market. The nurseries have required new land clearing and planting equipment, and the Forest engineers have developed it. For every dollar spent on access roads, there has been a saving of around \$30 on timber hauled.

Accurate mapping of the 181 million acres of National Forests is a "must" not only for road location, logging, and firefighting, but also for general access to the Forests. The making of maps in the early days of the Forest Service was a tedious and costly job, but, with the advent of photogrammetry, all that is changed. Not only are the newest aerial mapping methods giving accurate topographic maps, but expert Forest Service survey technicians are using the latest equipment and methods to keep these maps up to date with a minimum of field work in the winter.



Berthoud Pass, Arapaho National Forest, Colorado.

The KEK plotter invented by Jack King, John Elliot, and Phil Kail was effectively used during World War II to produce "quickie maps" of South Pacific islands at a Forest Service hideout at Gettysburg, where I helped find housing for the 50-man plotting crew and families and shuttled much Navy field survey data to the secret map factory, which turned out maps to be flown to the war zone with incredible speed. Now these mapping experts use even newer methods in turning out superb forest maps under the direction of Ed Massie. Ask Matt Walker of Region 2 about this. He knows all about it.

It turns out as time goes on that the water resources values in the National Forests are becoming a major consideration, and it was in this extensive field that I became most absorbed. Located as they are on the forested hills and mountains that form the roof of the continent, the National Forests naturally become the source of much of our best hydroelectric power. Furthermore, most of our Forests are in the mountains of our semiarid West, where irrigation originated the saying that "Little drops of water on dry grains of sand make a helluva difference in the price of land."

Domestic water supply being the highest use for the water resource, it is interesting to know that over 18 million people in 1,200 communities received water from National Forest watersheds in "the fifties." The number has been increasing rapidly.

An analysis of the relative values of the resources on the well-known Arapaho National Forest on the western slope of the Rockies, 70 miles west of Denver, Colorado, discloses that the watersheds of this Forest receive



*West Portal Moffat Tunnel on Fraser Road, Arapaho National Forest, Colorado
(Billy Woods sawmill replaced by Winter Park Ski Resort).*

heavy precipitation in the form of both rain and snow from western storms and deliver the resulting water through the Moffat Water Tunnel to the eastern slope to supply Denver with over 100,000 acre-feet of clear mountain water a year.

An inventory reveals a heavy preponderance of value in favor of the water resource. Priorities are water 1, recreation 2, timber 3, wildlife 4, grazing 5, and mining 6.

The same is true of many other Forests, and it will be more pronounced every year. Some Forests in Wyoming may favor grazing, in Oregon timber, or in California recreation, but more and more it will be water.

Every year about 2,000 power license permits for hydroelectric power development on the National Forests used to come across my desk. A long look into the future is mandatory in such cases as the strategic watersheds on National Forests in the West will soon feel demands for multiple use that were not dreamed of a generation ago. This will be especially true in California, Arizona, Colorado, and the Northwest. Provision must be made for power development with minimum interference with other resource values. The time will come when the public will comprehend what a good resource guardian the Forest Service is with its slogan, "The greatest good for the greatest number (of people) in the long run." A few of us foresaw this 40 years ago.

Frank Heintzleman, Regional Forester in Alaska for many years and, after retirement, the first Governor of the new 50th State, showed great foresight

in cooperating with the U.S. Geological Survey in the establishment and maintaining of numerous stream gaging stations, the long-term records of which are proving invaluable in water and power studies. Frank was a pioneer in recognizing the value of the water resource.

In connection with investigations for hydroelectric power projects in Alaska, we flew in to the Indian Lake Camp of the USGS triangulation party by amphibian plane. The survey party was 2 weeks ahead of schedule due to the use of helicopters, which placed the men on a mountain in a relatively few minutes so that angles could be turned under favorable conditions, whereas the men had formerly spent hours climbing only to find that fog had rolled in before they reached the mountaintop.

The boys were sporting the usual assortment of black, brown, and red whiskers, but the camp cook was serving canned beans instead of the usual beef and ham. It seems he had placed his quarter of beef and hams on the glacier to keep them in good condition. When he went to cut off some steaks, he found bear tracks, but no steaks. Infuriated, he hid behind some rocks with his ubiquitous rifle, and soon the bear returned for more meat. He shot the bear and reasoned to himself—now I have bear steaks as well as my own beef steaks. It was such a huge Kodiak, however, that the cook had to return to camp for help. The boys didn't return until dark, but agreed to lay off work after breakfast long enough to do the job. When they reached the glacier, there was no bear, only wolf tracks. They asked us to send them more meat.

The extensive water power investigations in southwest Alaska by J.C. Dort and R. Robinson Rowe prior to 1924 were made available in published form by the Federal Power Commission in "Water Powers of Southeast Alaska," on which I was happy to collaborate in 1947. This undeveloped resource that the Forest Service had so long had "in cold storage" will eventually justify the long-term water flow records initiated by the Forest Service.

Cummings Dort, who made the 1924 report on "Water Powers of Southeast Alaska," used to tell me how he did the field investigations by boat.

He was a good engineer and friend.

No doubt he derived inspiration from Fred Fowler, Regional Engineer of Region 5 who later became president of the American Society of Civil Engineers and then an advisor to the U.S. Government in D.C. When in Washington, he lived a few blocks beyond the Mayflower Hotel, where it was difficult to catch a taxi to work, so he would enter the side door of the Mayflower and emerge through the front door where the doorman would have a taxi waiting with open door (a smart Forest Service grad).

The Forest Service has been blessed with wise, farsighted, able, and dedicated Chief Engineers, men of vision, conversant with new discoveries in their minds. They always have had both feet on the ground and plenty of good, common "horse sense," which is stable thinking.

T.W. Norcross was the "slow but sure" type. What he accomplished for his beloved Forest Service was by dint of hard work. Singing with the Chevy Chase Chanters and gardening were his relaxation.



Chief Engineer T.W. Norcross, Region 7 Regional Engineer Cummings Dort, Dam Engineer Cliff Betts, and Field Engineers testing Pennsylvania dam model.

“Tony” Dean was the broad-minded cooperative kind of skillful engineer before whose friendly logic all opposition melted. He accomplished much good for the Forest Service and left a worthy successor. Now the Cosmos Club enjoys Tony’s talents.

Speaking of the Cosmos Club, the following Forest Service men have been members: Dr. Arthur Dayton, world authority on botanical nomenclature; Lyle Watts, Chief of the Forest Service; Earl Clapp, Chief; Ray Marsh, Les Harper, Chris Granger, Assistant Chiefs; Lloyd Swift, Marshall Wright, Tony Dean, and the writer. Frank Heintzleman used to be seen there often when in Washington, and Pete Hanson and other supervisors had guest privileges when in town.

Forest Service personnel who had an opportunity to attend the annual “Baked Apple and Gingerbread” meeting of the Society of American Foresters at the historic Gifford Pinchot home on Rhode Island Avenue, with Mrs. Pinchot as hostess, were fortunate. There was the huge library where the first Chief planned the Forest Service with President “Teddy” Roosevelt and members of Congress. Now it is gone, but the memory lingers.

For years, I had the good fortune to be in the car pool with Chris Granger, Les Harper, Dick Hammat, Warren Murphy, and for awhile Herb Storey.

Having worked under Chiefs Graves, Silcox, Watts, Clapp, and McArdle, I feel that the leadership of the Forest Service is of the best.

When visiting my Ph.B. alma mater, Yale, I always went up to the Forestry School to see Dean Henry Graves, who, if Pinchot was Father, must have been Godfather of the Forest Service.



Sign on Maine highway after the big fire.

After the 1936 hurricane caught me in New England, I went to that New Haven office to contact the Washington Office regarding participation in the huge timber salvage job in Maine, New Hampshire, and Vermont due to blowdowns.

The governors of the northern New England States had asked for assistance from the Forest Service, and they received emergency Forest Service know-how just as they did subsequently in the forest fire holocaust in the Bar Harbor area. When a Montana Forest Service fire boss ordered 50 Indians (portable pumps), consternation reigned in the Maine headquarters.

During the hurricane, I was inspecting a Connecticut dam near Norwich. The Irish foreman had his men stay behind the dam to avoid flying debris. When he ventured out to attempt to bring his new truck there too, he was pinned in the mud by a 2-foot-diameter falling tree. He was rescued by digging a hole under him, but I found, after cutting off his clothes, that no bones were broken. He said, "I was in the World War, but this is worse."

My first acquaintance with the Forest Products Laboratory in Madison, Wisconsin, was when I lived at the University Club there while working on my master's degree in hydraulics under a scholarship at the University of Wisconsin. Harold and Norman Betts lived at the club and used to take me over to the original laboratory near the university in the evenings and explain the research work being carried on. Later, Harold wrote many books on various species of trees and became a wood expert who testified about the ladder in the Lindberg trial. Norman was struck from his horse

by lightning. I still have the Winchester duck hunting gun I purchased from him.

When the Forest Service was handed the emergency job of producing much-needed rubber from guayule early in World War II, I was assigned the procurement of equipment. With war shortages everywhere, it looked like "Mission Impossible," but do not underestimate the Forest Service. Within 6 months, we had \$100,000 worth of tractors, trucks, farm equipment, laboratory equipment, precessing machinery, and electric motors (the last purchased from a firm that rewound burned-out motors). Some of the rolling stock had become surplus when the CCC was disbanded.

Early in the expansion period of Forest Service work, it became necessary to establish Service-wide standards, and this, in turn, demanded handbooks on Roads, Trails, Bridges, Signs, Buildings (including building with logs), Communications, Equipment, Safety, Landing Fields, Mapping, Water Supplies, Sanitation, Water Power, Water Control Structures, including Dams, Water Developments, Erosion Control, and many more.

After I completed "Water Developments and Sanitation," I worked closely with the Public Health Department on "Rural Water Supply and Sanitation," "Rural Sewage Disposal," "Individual Sewage Disposal Systems," and others that have been used throughout the country.

The booklet "Water and Our Forests," prepared jointly with Research, has had several reprints.

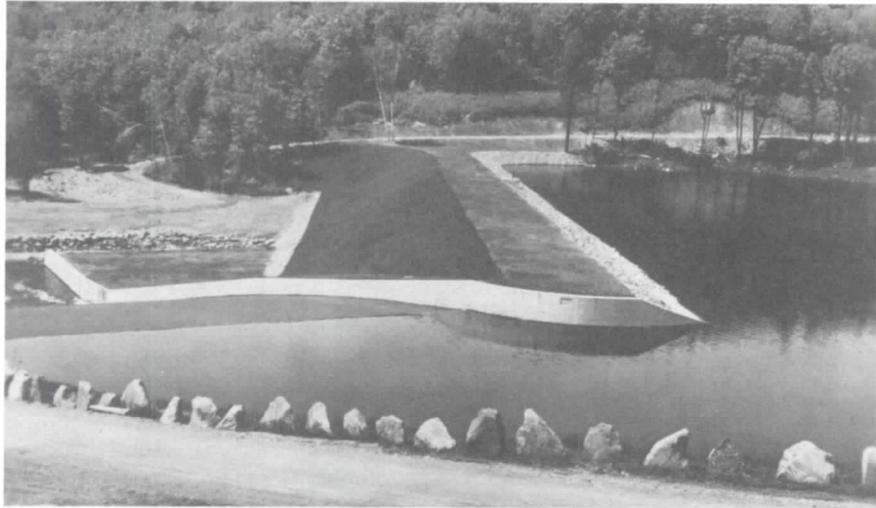
The latest thinking in Engineering went into these books, and this required nationwide engineering contacts.

For example, as member and President of the National Capital Section of the American Society of Civil Engineers (with 50,000 members), I received all their civil engineering publications. As President of the District of Columbia Engineering Council representing over 7,000 engineers of all disciplines, I was conversant with the entire engineering field. The same was true as President of the Washington Society of Engineers, which included all branches of the profession. This keeping in touch was encouraged by the Chief Engineers and will undoubtedly continue as the phenomenal growth of Engineering knowledge speeds ahead. Latest soils mechanics criteria and concrete standards were set out to the Regional Engineers to assist in the control of the quality of Forest Service work. Where hydrologic data were available, they were sent to the Regions to facilitate determining spillway and waterway capacities.

Patented automatic flashboard gates that would swing down and increase spillway capacity under a predetermined flood head were used on several recreational dams, saving the cost of a larger spillway. The writer shared the patent with the Forest Service.

Especially noteworthy has been the research on transportation and its costs, which have had a major impact on Forest roads and traffic.

In connection with Engineering cooperation with Research, I recall saving the Coweeta Research Center from being ruined by having the Sky Line



Spillway and stilling basin, Cherry Plains Dam, New York, 1938.

Drive go through the middle of its test areas of experimental cutting for flood control. The Park Service and Road Department relocated the road to avoid the area, thus saving an investment of \$100,000 and results of 20 years of comparative studies that were beginning to show the answers. Dick Hertzler, Charlie Hursh, and Richard McArdle of the Ashville Experiment Station were delighted.

My engineering contacts with the Corps of Engineers and U.S. Bureau of Reclamation also eliminated many problems. When the Hungry Horse Dam construction necessitated the substitution of mountainside timber hauling roads for the easily maintained valley haul road, I went to the Chief Engineer of the USBR to intercede for "replacement in kind"—i.e., grades, width and curvature comparable with the economical valley road—not just another road that would not serve the logging so well.

When I returned to the Forest Service as Dam and Water Resources Engineer in 1934, I was asked why an Engineer who had been on the nation's longest tunnel and the highest dam would be interested in the Forest Service.

I explained that I had "sawdust in my blood" because my great-grandfather had a sawmill in the Connecticut hardwoods that was burned by the British in the Revolution, and my grandfather and father had mills along with other activities.

While big jobs are spectacular and receive publicity, the aggregate worth and value of conservation work of the Forest Service affecting 10 percent of the people of the United States far exceed any individual projects.

I do not recall taking any sick leave during the two decades I was in the Forest Service, and when I resigned from the Service just before reaching



Hungry Horse Bridge, South Fork Flathead River.

the 65-year mandatory retirement age to do water supply engineering in Chicago rather than be retired, I had accumulated over 90 days of unused annual leave. One must love his work to do this; but who wants a vacation when, in the line of duty, you can inspect 15 miles a day of horse trails in the beautiful Chamberlain Basin Wilderness of Idaho on the Salmon River drainage, where bridges must be kept in good shape for the rescue of smoke jumpers or to serve hunters or administrative personnel. This was a favorite Wild Area of Forester Lyle Watts, Chief Engineer Tony Dean, and Engineers Arvel Anderson, Ted Littlefield, and Marshall Wright.

Not far from the Chamberlain Wilderness and northwest of the rugged Sawtooth Mountains of Central Idaho is the old Grandjean Ranger Station. With horses from there we rode some 40 miles from sunup to 10 p.m. (moonlight) and finally reached a little mining cabin where the two miners were about to shoot the daily round in the mine heading so that the powder fumes would be dissipated in the morning so as to permit mucking out the heading. While they did that, we tended to the horses.

The next morning, being the first up, I started to get breakfast, intending to give the miners a treat by making biscuits, but getting too much canned milk in the batter and finding no more flour, I had to settle for hot cakes.

About then, one of the miners sat up in bed, put on his flannel shirt and hat, and rolled a Bull Durham cigarette. Then he asked, "What do you do with old dynamite that's been frozen and you daren't move it?"

I told him about an ex-miner in Denver who was taking some in his car to bury it on the prairie, when he hit a rough railroad crossing. The explosion broke a hundred or more windows nearby and they had to bury the miner instead of the dynamite.



Grandjean Ranger Station, Boise National Forest, Idaho.

“Well, you have been sleeping on them two cases of old dynamite,” he said.

We never stopped there again.

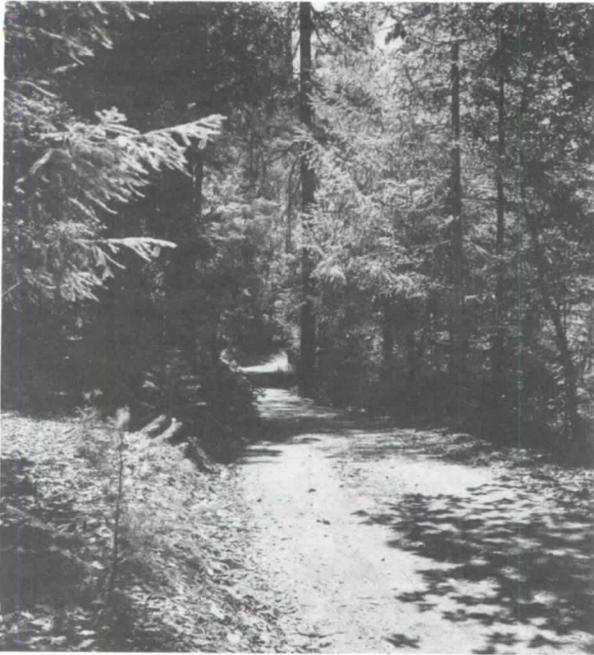
In writing this exposé of the Forest Service Engineering “secrets,” I may be sitting on a powder keg, but I guess I’ll live through it like I did sleeping on dynamite.



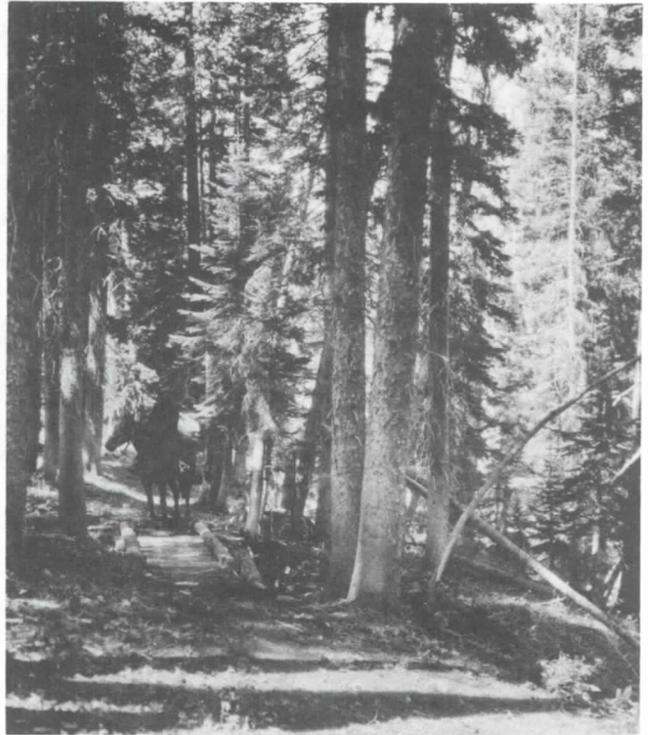
Red Fish Lake and Sawtooth Mountains, Idaho.



Deer on the Boise National Forest, Idaho.



*Forest road, Mendocino National Forest,
California, 1938.*



*Trail on Nash's Fork Creek, Medicine Bow
National Forest.*



*Detailed view of cross section near Station 20, Neihart Project, Jefferson National
Forest, Montana.*



Elk Creek Bridge, Jefferson National Forest, Virginia, 1938.



Historic Daniel Boone Tree, Tennessee (preserved by owner of land after it blew down).

Ramblings of a Retired Forest Service Engineer

J.H. Lawrence

I am very reluctant to start this narrative for several reasons:

- (1) It cannot help but sound as an autobiography, which is not intended.
- (2) The use of the pronoun in the first person singular will be unavoidable.
- (3) This narrative, belatedly started, will consume quite a bit of time.

I am reluctantly imposing on a stenographer from the Division of Engineering and to her would go much of the credit if anything comes out of this. I think it is only fair to tell you that her name is Marina Camia.

The only woman who will be named in this narrative is Elsa Schmieder, who occupied an important position in the Division of Operation when I first came to the Forest Service.

Just in conclusion of my introduction, let us make this statement. I will prepare this narrative in three sections, not counting the introduction. The first will be the period from May 1920 to beginning of the CCC program in April 1933. The second will be the period April 1933 until the middle of 1938. The third will be the period between 1938 and 1960. This I will call the desk chair period.

I might as well start at the beginning. I first came to the Forest Service in October 1919 after having passed a physical examination in the Civil Service Commission Office in Washington, D.C. The examination was for Forest Ranger in Mt. Shasta City. The name of the City when I first came there was Sisson and before that it was Strawberry Valley. I applied for that examination because the advertisement showed a man riding a horse and I envisioned a lifetime of horseback riding. Being an ex-cavalry man, the ad appealed to me greatly.

There was not much chance for me to ride a horse after I got appointed as temporary Ranger because I happened to be doing some drafting work for the Shasta National Forest.

Then S.W. Wynn visited the Shasta and requested that I come down to San Francisco to what was then called the District Office. The drafting work that I was doing at that time was designing two "chick sales"—a one holer and two holers. So, in February 1920, I took up my duties as copyist topographic draftsman at \$1,320 per year.

The organization of the District at that time, as near as I can recall, was District Forester Paul G. Reddington; Chief of Operation—Robert L. Deering; and reporting to him were Chief of Fire Control—Ed Kotok; Chief of Personnel Management—Paul P. Pitchlynn; District Forest Inspector Chester E. Jordan, who was responsible for roads and trails, designs and construction, and building improvements; and telephone maintenance, which was under Fred Hafley.

I failed to mention that under Bob Deering was also the Branch of Procurement and Supply headed by Elsa Schmieder. The Division, which is now known as Information and Education, was headed by Rich F. Hammatt. Legal activities were the responsibility of Harry P. Dechant. Chief of what was called Grazing, as I recall, Chris Ratchford; and Timber Management, T.D. Woodbury. Beveir Show, W.W. Wagner, Ed Munns, and Dr. Hunt—these four people to my best recollection were grouped in a research unit.

The District Engineer was Frederick Hall Fowler, a charming, able, and distinguished gentleman who made everyone, regardless of his status in the organization, feel at ease. He became famous for the publication that he prepared that is now a U.S. Geological Survey bulletin. The title is *Hydroelectric Systems in California*. I do not recall the number of this publication, but it was a masterpiece of planning and composition. I do not think he had to worry about money because he used to come to work in a large chauffeur-driven automobile. Upon leaving the Forest Service, he became a consulting engineer and was a consulting engineer to the Army at the beginning of World War II. He had responsibilities for reviewing all project proposals for various power companies, for plane construction of streams in California, and was the representative for the Federal Power Commission on these projects. His principal assistant was Joseph Cummings Dort, a very able engineer and one who gave me my start in design of bridges.

J.C. Dort was the first Regional Engineer with headquarters at Atlanta, Georgia (Region 8). As I recall it, for 2 years (1921 and 1922) during the summer months, he was detailed to Alaska to examine, review, and make tentative plans for hydroelectric power possibilities there. I feel quite certain that his reports were published, but do not recall having seen them.

Sid Stoner was Chief of Maps and Surveys and Drafting, and I started work under his general supervision. He was an old-time U.S. Geological Survey Topographic Engineer and when his field work was done, as I recall, he spent quite a bit of his time during the winter months reading the *Saturday Evening Post*.

The Acting Chief of Drafting, shortly to become Chief of Drafting, was Herman A. Sedelmeyer. I was astonished to see him in his office, since we had both worked in the Chief Ordnance Office, War Department, Washington, in the old State, War and Navy building near the White House.

Our field season started in May of that year, and our first project was on the Modoc National Forest. I remember that our automotive equipment consisted of two old Army Model T Fords. Each held up pretty well. At one time, we could reach the speed of 45 mph. We traveled through the Sacramento Valley, stopping at the town of Arbuckle overnight, and drove

on through the little town of Adin. The road up the Sacramento Canyon from Redding to Alturas was barely two lane, and was graveled.

I recall the name of the District Ranger of the Big Valley District, whose headquarters was at Adin, was Bramhall. I particularly remembered him because he had two beautiful horses. We were engaged in field preparation of a topographic map of the Modoc Forest. My particular assignment was making cross country traverses. My equipment consisted of an Army sketch board 14 inches by 14 inches, a Forest Service compass, and a pacing tally. In other words, distances were not measured except by the number of paces in a distance. The sketch board was connected on a stiff-legged tripod, which at times became very tiresome to manipulate.

I had several interesting experiences during this period. On one trip, I discovered what the word "bull" meant. I came down to a pleasant pasture full of a herd of Hereford cattle—the big white-faced ones. I might say that cattle on the range lost quite a bit of domesticity, but I was not bothered going among them, except on one instance. I heard a terrific roar—saw dust flying through the air, and the herd parted, and here was this huge bull. I suddenly decided to take cover. I located the nearest tree and I remembered the Colt .45 automatic pistol, which I had carried to shoot rattlesnakes, and stood my ground waiting for his charge. Well, he made some more noise, and seeing that he did not make me run, he took the herd with him, and to me, this was an excellent definition of bull—lots of noise, but no action.

If you have recently been in the Modoc Lava Beds, undoubtedly you will find it criss-crossed with roads and trails. The landscape was similar in all directions, so that if you were not traveling by compass, it was difficult to find your way.

On one of my long traverses, I borrowed a little mare from Leland W. Smith who was in charge of Grazing on the Modoc at that time. Having a horse to ride and having some time, I did not hesitate to work until about dusk. I turned my horse's head to what I thought was home. At about 10:00, after the horse had repeatedly turned her head to the left, I gave her her head and she turned sharply to the left. We reached the camp about midnight, just in time to pass three porcupines coming out of the tent, but not before they had ruined Sid Meyer's Stetson (they separated the crown from the brim). We killed them with a shovel, but the damage had been done.

Another thing I meant to mention when I spoke about killing the porcupines. I had read that porcupines were protected in some of the southern desert areas because they were the only source of food for people who were lost. We decided to see how palatable these porcupines were, so we had the cook skin and dress one of them. He boiled him in a pot all day, and a night we tried to eat him. The meat was so tough you would have to sharpen your teeth to get a bite. I suppose to starving people it would taste better than shoe leather, but we could not eat it. Fortunately, the cook had prepared a regular meal.

I forgot to mention that it was on this trip that we met Fred P. Cronemiller. He was making a range survey on the Modoc and were glad to see him

particularly because of the excellent brew that he could make from juniper berries. Later, as you all know, Fred Cronemiller became the first Chief of the Division of Range and Wildlife Management in San Francisco.

The following year, our project was making a topographic map of the Mendocino Forest. We had obtained several horses and two mules on transfer from the U.S. Geological Survey, so we no longer traveled by foot except where our work necessitated. I recall my personal assignment was to ride with Sid Stoner, helping him set up his plane table and hoist his big umbrella, which he used to shade his instruments from the sun. He would set up his table on a strategic point, and using his alidade for direction finder, he would sketch contours many times just by appreciation. Most of the time, his delineation was pretty accurate, due to his long experience with the U.S. Geological Survey.

Later in the year, we went up to Covelo. Douglas Robinson was the District Ranger. He later transferred to the Inyo Forest. He had little need for a car since there were few roads traversing his District. One day, Sid Stoner started to crank his Model T Ford and the starting crank whipped around and broke his arm, so Don Hoffman took over as Party Chief. One time we were returning from Covelo and the lights went out. Not being able to see in the darkness, we hit a rock and bent the front axle, and walked the rest of the way back to camp. It wasn't too serious since these old Model T Fords were easy to repair—remove the axle, put it over an open fire, heat it, and bend it back to straight. Try and do that nowadays.

The following year, we continued our Mendocino mapping, but this time I was assigned the job of triangulation. I occupied most of the peaks in Mendocino County with a transit measuring angles between many known points. At that time, we made five complete 360° readings with the transit normal and then plunged the transit and made five more 360° readings. I was very happy to find that my readings were in sufficient accuracy for the superperfectionist, L.B. Lint, who many years later was making a resurvey of the Mendocino and commended me for the work I had done.

By the way, how many of you people who read this know that "Tiny" Lint, along with others, made history of national significance. Colonel Birdseye, who I think at that time was Chief of Topographic Division, U.S. Geological Survey, organized a party for an exploratory boat trip down the Colorado River. In the early 1920's, if I recall correctly, Lint was a pilot on one of the boats on this historical trip. It was the first time, I believe, that any white man had gone the length of the Colorado River by boat, and if you know the river as I do, riding this muddy course and going through the many rapids was quite an undertaking. Lint told me (and I believe him) that he was successful in overturning his boat and dunking Colonel Birdseye in the muddy Colorado—and I mean muddy.

In my desire to complete this narrative in as short a time as possible, I have overlooked recording some things that are of considerable importance to me.

Our first camp in 1922 was at Gravelly Valley just below Scott Dam, which impounds the waters of the Eel River at Lake Pillsbury. This is where we got our consignment of horses and mules, as I recall, five horses and two mules. I selected a big young red bay horse who we called Bill. The

animal thought he was still a stallion, and I believe he was half stallion. In all my hours and days and months of riding, I had no trouble with him. Any place I wanted to go, he wanted to go too, but after we stopped and I set up my transit for triangulation, he was tied to a tree and would roar almost continually just to attract the attention of someone or some animal. Of course, I would take a measure of grain for him to eat, but regardless of how tired he was, if I stopped, he never failed to sound off. He was admired by many cattlemen.

I want to cite two instances that make me recall Old Bill so vividly. Bill was steady, never slipped or stumbled, and this is surprising because he had such large front feet. He took the largest malleable shoe that was made. One day he lost the shoe on his left foot, so it was my job to put on a new one. It was quite a job because just as I got started Don Hoffman rode off to the post office on his little ewe-necked mare who was the particular pet of Bill Horse. I put on the halter and tie rope and tied him to the tree and also put a rope around his neck. As I expected, he broke the halter in an effort to get away and go along with the little mare. It was necessary for me to put a half hitch around his lower jaw to keep him somewhat still so that I could lift his foot and put on a new shoe. When I started putting in the nails he calmed down quite a bit, but I guess it was because he did not want me to put the nails in wrong. After about an hour, he had his new shoe on and was quiet.

One time in the spring of 1922, there was more or less a drought in the mountains and the forage was very sparse. As you know, you can feed a horse grain, but unless he has something bulky to fill his stomach, he just cannot make it. Bands of sheep grazing under Forest Service permit on the range that we covered completely denuded the area of any grass or other forage. Following up on the band of sheep was a band of goats, and they browsed, many times on their hind legs, on palatable brush that horses or cattle could subsist on. We had plenty of grain, but without rough forage most of our animals went down pretty rapidly.

One time we came into a place properly called Frying Pan. It was lush with garlic and wild onions, which the horses ate with relish. One particular feature in this, it did not matter whether you were riding in front or behind, garlic permeated the air.

I might also state that another member of the party shot down a forked-horn buck. He was so poor that you could not get palatable steaks or other cuts from him, so we used a dutch oven. In our case, it was a cast iron pot about 12 inches in diameter and 8 inches deep. We (I say we, actually I did not have anything to do with the cooking—I took care of the stock) cut up slices of meat, potatoes, and onions and put them in alternate layers in the oven. Then we dug a hole about 3 feet deep, got a bunch of hot coals from the fire, which we had previously built, put a layer of them in the bottom of the hole, lowered the dutch oven on top of them, and covered the oven with about 12 inches more of hot coals. We scraped dirt on top of this, taking care to have a long pullout wire attached to the bail of the pot. Then we went away and left the stew cooking for about 8 hours. When we returned to camp, we pulled the oven out of the hole and uncovered a delicious and tender stew. All of the flavor of the meat was retained in the

cooking process. I have to mention this because it really gives a person a very savory meal without standing over it and cooking.

Now back to my story—we decided that we should move camp from this forage denuded area to a place where the animals could get sufficient hay. So we decided to go to Ball Rock where there was a lookout and an adequate supply of hay and grain. I was riding old Bill Horse. Half way there, he gave out completely, so I unsaddled, put the saddle on the big brown mare, and walked, leading him about 6 miles over a trail that we had never been on. I was walking about 500 feet, then letting him stop to breathe. It was about 2:00 in the morning when I saw the light in the lookout and shortly was able to turn him into a corral where there was plenty of hay. He recovered completely in 3 day's time and was again a young, husky horse.

He never forgot the trip in April of 1923. I was sent to Stonyford Ranger Station to gather up the horses and mules and take them across Snow Mountain Summit to Potter Valley to get them shod. I had four horses and two mules in the string. Old Bill Horse was raring to go but living on grass and rough pastures all winter hadn't built up much stamina in him, and when we hit the snow, I had to change to this big brown mare who was not as anxious as he was to get the trip over with. As I recall, I was with Bill Derby, Assistant Forest Supervisor of the Mendocino (called the California Forest at that time), and we took turns breaking trail through the snow, which was girth deep on the horses. Incidentally, John D. Coffman was Forest Supervisor. He later became Chief of Fire Control of the U.S. National Park Service in Washington. Once we got to the summit, below was opened up large areas of green pastures called glades, so we stopped for a few minutes. It was before sundown, and I counted over 160 deer grazing—it was a beautiful sight. Well, we were not out to kill any deer so we rode down to a shepherd's cabin, which was closed up for the winter, opened it up, and got busy chasing out the pack rats.

If you are not acquainted with pack rats, they have very peculiar habits. They are not obnoxious like city rats except there are so many of them. Time and again, they would come to camp and if you left any grain, open Quaker Oats, or left any shiny things like silverware available, they made off with it, but they always brought something in exchange, but—the only thing they could find to put in place of what they took was horse manure.

To get back to my story, about May 1923 I was sitting on a bench outside of the Hotel Maywood in Coming when another Forest Service Engineer came up and introduced himself as Edwin Kramer. He had replaced J.C. Dort, previously referred to as assistant to District Engineer Fowler. He knew that during the winter I had worked on drawings of several bridges that the Forest Service constructed, so he asked me if I would be interested in taking over the construction of a bridge above the Covelo Ranger Station across Black Butte River, at that time called the Middle Fork of the Middle Fork of the Eel River. Naturally, I jumped at the offer and thereby came my experience as a bridge designer and construction engineer.

The bridge consisted of a 119-foot through span with the 36-foot pony trusses as an approach span. The false work had been cut the year previous, and construction was to have been started that year, under Fred Bowles who

had constructed several other bridges for the Forest Service. I inherited some of the his old bridge crew who were qualified construction men. Two principal ones were Pat Callahan (much about him later) and Bill Bleck, who had at one time been a rigger on a German sailing ship. Also inherited some equipment, one 1 1/2-ton White truck, and a 3 1/2-ton Packard truck. Both were old, used, and abused Army equipment. Also, there was a half cubic-yard old concrete mixer of the hit or miss type. There was no power equipment, nor air compressors, jackhammers, or gasoline hoists. So the bulk of the job had to be done with block and tackle for hoisting purposes, plus a 2-ton chain hoist, a 2-ton "crab"—a hand winch. My first job was to recover the old false work and to erect the false work. Realizing that we had to lift many of the truss members 20 feet to place them, I designed a "jinny-wink." This consisted of an A-frame with a stiff leg and an 8-foot boom. I sent some of the boys out to cut the timbers we required for this jinny-wink, and they brought back good straight timbers so they may have come from private lands. The timbers on first appearance looked sound, but I soon found that they were young growth or second growth and were brashy. We were lifting a still leg and were just about to place it on the pin at the top of the A-frame when the timber suddenly twisted and it broke about 2 feet from the upper end. The timber fell, hit me a glancing blow on the head, knocked me temporarily unconscious, and I was about to fall over the false work into the white and cold waters when Pat Callahan saved my life by giving me a sharp blow on the legs, and I recovered consciousness just in time to dodge the other two timbers that were falling. So, I had hardly begun my bridge career before it was almost ended.

Pat was a large-boned Irishman, about 6 feet, 2 inches, who liked hard liquor and was deathly afraid of snakes. One time, one of the boys dropped a big snake in the concrete chute for the foundation where Pat was helping lay out the mat we had poured. The snake dropped at his feet. I looked and saw that it was not a rattlesnake, but Pat turned green, and he was all for killing the two birds who dropped the snake down the chute. He earned a degree of fame by making a trip on the train that brought President McKinley to San Francisco. He was not a paying customer, though, as he was riding as blind baggage. There were several other incidents in connection with the construction, but they would occur in any construction job.

I was amazed to see how nimble Bill Bleck was. The top cord of the truss was 14 inches wide, and he would walk that as though he was walking a 6-foot sidewalk 50 feet above the water. Not only that, he would wield an 8-pound "double jack" driving drift pins as though he were standing on the ground.

We completed the bridge in September, and then part of our crew moved to the Stanislaus, and half went to the Tahoe for some bridge construction by Tahoe forces. They took with them the Packard truck and the concrete mixer. The truck driver of the Packard, who constantly carried a gun on his hip, went to the Tahoe. I learned later that he and another employee decided to quit and drove off in the Packard truck. They were later apprehended by the local sheriff.

We took our equipment and tentage to a bridge site below the Dardanelles. It was called Wagners Crossing. We landed there on Sunday night with no time to erect tents, or even to set up a cook shack. The next morning we

were faced with a problem of who was going to cook or who could cook. It wound up with everybody cooking for himself over an open fire.

Just as we about despaired of getting any assistance, there appeared on the scene a short one-eyed chap who looked like a tramp. Accompanying him was a handsome rugged individual who we signed up for the crew. His name was Henry Miners, and he was a good carpenter and handyman. He had the distinction of having known the famous Sierra bandit, Joaquin Murrieta, who had stopped at his father's ranch for some days. The one-eyed man was "Coyote" Bill Hinicker who turned to and soon had breakfast going in good shape. The fact that he was not the cleanest man did not matter, because he cooked a delicious breakfast and thereby became our bridge crew cook.

We had hardly started the foundation for the bridge when we became temporarily snowed in, but that soon melted, and we completed the bridge in short order.

One of the crew found a den of rattlesnakes all coiled together, hibernating for the winter. A couple of sticks of dynamite gave them a permanent resting place.

Our next job was a trail suspension bridge at Hell's Half Acre. It was a 135-foot span, about 50 feet above the water. It was the first suspension bridge that I had constructed, and after I started to assemble the truss, I became quite alarmed since everything seemed to be going downhill. But I followed the plans and sure enough, it adjusted itself to design camber.

It was the rule that anyone who dropped anything in the river had to get it out, and naturally, I would be the first one to do it. The diagonals on the truss were flat bars, and one slipped from my hand and fell between two boulders. Since I could not swim, they let me down on block and tackle. The water was cold, but we recovered the bar.

For this particular job, I picked up two additional local men. Both were hard rock miners. One was Rufus George, a French Canadian about 4 feet wide and not more than 5 feet, 6 inches tall. He was a powerful man. The other was a dapper little chap with a handle bar moustache, and although he wasn't more than 5 feet, 4 inches tall, he could wield an 8-pound hammer all day along with the best of them. He and Rufus made an excellent team. He was very talkative, and Rufus was very much self-contained, almost to the point of being taciturn.

I found he had another side to him. In the evening, we would build a campfire. I had a good harmonica and often played it. One night, I played La Paloma, and after the rest of the crew had gone to bed, he asked me to play it again for him. Draw your own conclusions.

They drilled eight 1 3/4-inch diameter holes, each hole 20 feet deep, parallel to each pair. This went on all day except for time out to light a pipe and to smoke a cigarette, for at least 8 days. They sure knew their job.



Hell's Half Acre, Stanislaus River, 1935. (This bridge is a Warren truss with inclined chords and a main span of 130 feet. The bridge replaced a 135-foot trail suspension bridge, which I had built in 1923—my first suspension bridge.)

Nate Miller introduced me to the term "Cousin Jack." A "Cousin Jack" was a hard rock miner from a group who came over from Cornwall, England, where they had been coal mining. They settled in a little town not far from Sonora, which was Soulsbyville. They warned me that these people were all interrelated. The men were "Cousin Jacks" and the women "Cousin Jennies." Nate told me that you had to be careful about making remarks to any one concerning one of them, as the one you were talking to was undoubtedly related. He told a story about a young Cousin Jack, starting to learn how to drill. He recited a conversation between two old timers. One said, "First time he hit him he missed him. Second time he hit him in the same damn place, you ----. Third time 'damn you old son ----,' he never hit him at all."

Just before completing the job, Mr. Dort came down to inspect for the Regional Engineer. I mentioned this because he had just lost his home and practically all his belongings in the great Berkeley fire of September 1923.

I learned how to make a "go-devil" and used it frequently as follows: It consisted of a heavy timber, the rear end of which was fastened to a two-wheel axle, the front end was shod with a steel shoe, the principle being that horses pulling this equipment would lift up the front going downhill. If the load began moving too fast, the traces would slack and the steel shoe would plow into the earth and act as a brake. It was a very efficient piece of equipment.

During the CCC days, this bridge was replaced by a 130-foot span steel truss bridge designed for logging trucks. It was, as a matter of fact, designed on our new H-15 loading specifications. Following completion of

this bridge, we moved to a lower elevation and built a 105-foot span suspension bridge, at what was called Halls Crossing.

There was no particular problem with this bridge, but along portions of the trail we went through a grove of California nutmeg trees. It is the only location I know of where these trees grow.

In reviewing this narrative, I find that I have failed to note a very important member of the District Forester's staff. He was A.W. Smith, in charge of Fiscal Control. He was a very helpful man, soft spoken, because of very poor hearing. He was the kind of man who would try to help someone who was in fiscal trouble. I have reason to know this because, during the construction of the Black Butte River Bridge, I unwittingly created a serious blunder in violation of the recently, at that time, enactment of the 8-hour law.

We were loading bridging steel from the Northwestern Pacific Railroad cars at a small station named Dos Rios. It was a long distance to truck steel from there to the bridge site. Also, it was very hot down in the canyon, and since the gang was willing, I decided to work them overtime. It worked out very well from the standpoint of getting the steel unloaded, since we could work in the comparative cool of the evening. Also, by getting the steel off the cars, we could save demurrage cost. I can imagine the consternation when the time slips for the gang came into San Francisco showing overtime. I don't know how A.W. Smith arranged to take care of my error, but he did, and all I got out of it was a light chiding with an order not let it happen again.

I might mention that in the early days, the Fiscal Control Officer (I don't recall the title) personally signed all the checks for the District Office and Forest personnel. He also could issue advance payments if the circumstances warranted it. You could make your request in the morning and get the check in the afternoon. Compare that with salary payment processes today.

It was shortly before Thanksgiving that we finished up our work for the season. The crew was disbanded, and I returned to Berkeley.

Nineteen twenty-four was a bad fire year. We started out to build a bridge known as the Keiffer Bridge, just below Wold Plum Ranger Station. The bridge consisted of two 50-foot steel pony trusses with a pier in the center of the stream. This was the only difficult part of the construction because it necessitated building a coffer dam around the rock on which the pier was to be constructed. I was fortunate to have Rufus George on the job, because with his mining experience, he was quite familiar with the job to be done. Briefly, we diverted the stream as much as possible and then drove piling by hand. We sealed off the bottom with sandbags so we had a fairly watertight enclosure in which to pour the concrete mat.

One day, while we were placing the trusses, we heard an explosion up on the side of the mountain and looked up in time to see a miner's powder house go up in flames. With a good strong wind blowing, it started out to be a big conflagration. Having some old timers with me like Rufus George and Henry Miners, and Frank Morales, a new South American Indian, we

built a firebreak up the mountain at the north and east, at their suggestion. We were making good time, and were within 400 yards of the summit when we heard a roar, looked down, and found that some State Division of Forestry man touched off a backfire below us. The Forest Service did not backfire its own firelines, and "backfire" was a bad word in Washington. We had all we could do to get to the top and behind a rock barrier when the fire crowned right over our heads. We let the crown fire die down for awhile and then rather easily constructed a firebreak to point of control. If we had been a few hundred yards down the mountain when the backfire started, we would never have made it.

It seemed that we spent almost a whole summer fighting numerous fires on the Tahoe Forest, so building a bridge took us longer than we expected. As a matter of fact, we did not get to our next bridge job until September.

The new job was on the Sequoia Forest. It was the construction of a trail bridge across the Kings River just below Bubbs Creek. It consisted of one 60-foot and one 80-foot truss, constructed of hand-hewn timbers. The chords of these trusses were 8-inch by 10-inch timber with steel rods for the verticals. Hewn timber was a new experience for me, but again, Rufus George and Frank Morales knew how to go about it. There was a stand of tall straight pine trees a short distance from the bridge site. They selected and felled the necessary trees. After limbing them, they prepared the trees for blocking with a chalk line and blue chalk held at both ends on marks that gave rough timbers about 10 inches by 12 inches. The trees were cut at 2-foot intervals down to this line, and the excess material was chopped off with axes. This had to be repeated on all four sides of the timbers. Then, they were again marked with chalk to the final dimensions of 8 inches by 10 inches, and then came the real job of hewing.

Rufus George did most of that job, using a 14-inch broadaxe. He would progress backwards along the timber, bringing the broadaxe down alongside of his foot. He was such an expert that the final timbers hardly showed a mark of the broadaxe. They were very smooth. This hewing went on for days without Rufus once hitting the side of his shoe. Frank Morales hewed most of the diagonal timbers, the stringers, and split cedar for the flooring.

I forgot to mention that all of the supplies and camp equipment as well as the men were packed into the bridge site from a back station at Big Meadows, 24 miles away. I also failed to mention that three of the previous members of the bridge crew from 1923 did not show up for this job or for the Keiffer Bridge job. I was told that Pat Callahan had died of TB; Bill Bleck, who had a very serious stroke of pleurisy in 1923 could not make it; and I was told that Nate Miller had taken his life because of unrequited love for a woman of easy virtue.

Toward the end of September we got snowed out, and we had to retreat to the canyon 4,000 to 5,000 feet below Big Meadows. All of the equipment that we had left at Big Meadows was under 2 to 3 feet of snow when we returned. We had to build many fires to melt the snow so we could truck the equipment out.

This was beautiful country to work in, and at the request of the District Forester, Paul G. Reddington, we took his son on as a camp assistant. It

was more work to keep him busy, and cost more than the value of the work he did. One day, the Sierra Club hiked up through the area, stopped at the camp for awhile, and then proceeded up Bubbs Creek. There was a very crude bridge constructed across the Kings River. It was difficult to get some of the burros to cross this bridge, and a member of the club offered young Reddington some fish hooks to help them get the burros across. The member later told me that he was surprised because the boy took a handful of them; he thought he would only take one or two.

On my return to San Francisco, I was called into the District Forester's Office and criticized for not feeding my men properly. His son had told the Sierra Club members that we had nothing to eat. I admitted we did not have fresh meat since it was difficult to pack it in 24 miles. I explained that everyone else was well satisfied with the food.

In the spring of 1925, we returned to complete the bridge. The snow was just receding, and as it receded, swarms of mosquitoes covered the area. Kerosene became a very acceptable face wash, and it prevented many a swollen face.

Under Rufus George's direction the preceding winter, the timbers had all been put on leveled poles and blocked securely. They were well weighted down, and when we uncovered them, they were as straight as a die.

We had one interesting diversion. A lightning storm hit the ridge above us, and struck a big tree on top of the ridge, which immediately burst into flames. Being good Forest Service employees, we felt it our duty to put the fire out. Well, it was about 4,000 feet up Avalanche Creek, which for the most part had a solid granite streambed. It took us over 4 hours to get to the fire, and after putting a line around to make it safe, we had to dig trenches or holes in the hillside so we could have a place to sleep without rolling down the hill. The next morning when we started back down, we found the easiest way to get down was to sit on our shovels and slide. It only took us three-quarters of an hour to get back to camp. With the showers of sparks flying from the shovels as we descended, it was a wonder that we did not start many other fires.

Perhaps I overemphasized on this particular project, but the use of hand-hewn timbers and knowledge of how to hew them was of value to me on other projects.

In 1925, we built several more bridges, the last one a bridge across the Stanislaus River at Dorrington.

In the spring of 1926, it was decided to make a State-wide survey of existing bridges needing replacement and survey for bridges at new sites. The Forests sent in a list of their requests, and we traveled to the old bridge sites on the list. We made a condition survey of all bridges requiring replacement and site surveys for new bridges. We also, for each crossing, supplied its location, distance from the nearest shipping point, and other data pertinent to preparation of new designs.

In addition to these bridge site surveys, we built three trail suspension bridges, one of these a 105-foot span across the Rubicon River, not far from

the town of Georgetown. One morning, I hiked up the trail to that town to get the mail and some supplies. When I arrived at the post office, many of the old timers were gathered there waiting for the mail. One of them, seeing that I was a Forest Officer, asked me, "Did you hear about the bridge the Forest Service was building down the Rubicon River? It has slipped off down the river just as we said it would." I said, "Well, that's very strange, as I am building that bridge, and when I left it about 2 hours ago, it was still in place. As a matter of fact, it cannot slip off that rock because we shelved the rock and put steel dowel pins in and poured concrete footings around those pins. If that bridge slips off, the whole canyon would have collapsed."

And down the trail, returning to camp, I rounded a sharp rock point and there about 50 feet away, standing on his hind legs eating blackberries, was a big cinnamon bear. I looked for the nearest tree, about 20 feet ahead of me, and having no weapon to defend myself, I figured that if he charged, I would go up the tree. I walked slowly toward him, and I think he was just as startled as I was, because after watching me for a couple of minutes, he let out a grunt and jumped up on the hillside through the blackberry bushes, so I walked by him. He must have been just waiting for me to get out of the way so he could get back to his feast.

One day I was driving to Truckee, and as I topped the Divide, I saw a great cloud of smoke from a fire down near Iceland. Again, being a good Forest Service employee, I volunteered to help fight the fire. Dewitt Nelson, commonly called "Swede," was District Ranger at that time. He got a crew of about 30 men and asked me to get them to the top of the Divide and wait for him. I started leading them, but soon found I had to get behind and push them because many were winos from Reno. Finally, we got up, after struggling hard.

I waited quite awhile, and no Ranger showed up, so I left the group at a good resting spot with plenty of fresh water, but no food, and decided to get back to the fire camp to find out where the Ranger was. I decided on the way to explore the fire, and I went across two ridges. I figured I made over 16,000 feet changing elevations. Finally, I arrived at the fire camp, and found the District Rangers and other firefighters enjoying a good ham dinner, which I immediately jumped into.

I do not recall the explanation of the failure to meet at our scheduled rendezvous. I was assured that the crew I had taken up the hill would be adequately fed. I could not go back myself, because walking through the fire, I fell from a rock and tore the sole of one boot halfway off.

Dewitt Nelson later became State Forester and then Director of the State Department of Natural Resources. Every time I saw him, I would ask him why he didn't meet me as planned, just ribbing him. I am narrating these instances, which have no relation to Engineering, to show that a Forest Service Engineer had many other things to do besides Engineering.

One bridge site I visited and made a survey of was on Golden Trout Creek on the Sequoia. I was accompanied by one of my crew whom I have not previously mentioned. He was Ralph Morris, an excellent bridge man who learned very quickly. A couple of years after this trip I am speaking of, I



Rubicon Bridge, Eldorado National Forest, 1931. (This is a suspension road bridge having a main span of 160 feet. The Construction Engineer was John H. Lawrence. This is a picture of Rigger Lawrence (Cholo) Madsen. I included this picture to show the difficulty we encountered in delivering equipment and materials to the bridge site. Madsen sat in this chair all day long making changes in the rigging system to permit lowering the materials from a height of 300 feet.)

used him as foreman in charge of construction of a trail bridge, known at that time as Rinkle Crossing of the McCloud River on the Shasta Forest. He did a good job. That season he returned to the National Carbon Company in Denver, and last I heard, he was an executive of that company.

To get back to my story, we made the trip early in the spring before the trail had been cleared of down timber. I particularly mention this trip because it was on this trip that we saw a wolverine. It was very rare to see one of these animals. They are the scourge of the trappers, since not only did they destroy any of the animals caught in the traps, but also with their powerful forelegs, they wrecked the traps, too. They seemed to like to destroy everything, and would break into cattlemen's cabins and generally turn everything upside down. I had my .45 with me and would have shot him, but we had all we could do to handle the horses, who had a great fear of the animal.

In the spring of 1927, we built a bridge across the Trinity River at a site known as Stoddard's Ranch. There was little sand and gravel available, so our concrete piers consisted mainly of large rocks called "plums." Anyone

who had to wreck these piers had a surprise. It was during construction of this bridge that W.G. Mitchell started to work as a steelworker. He later became my bridge foreman and was with us for a long time.

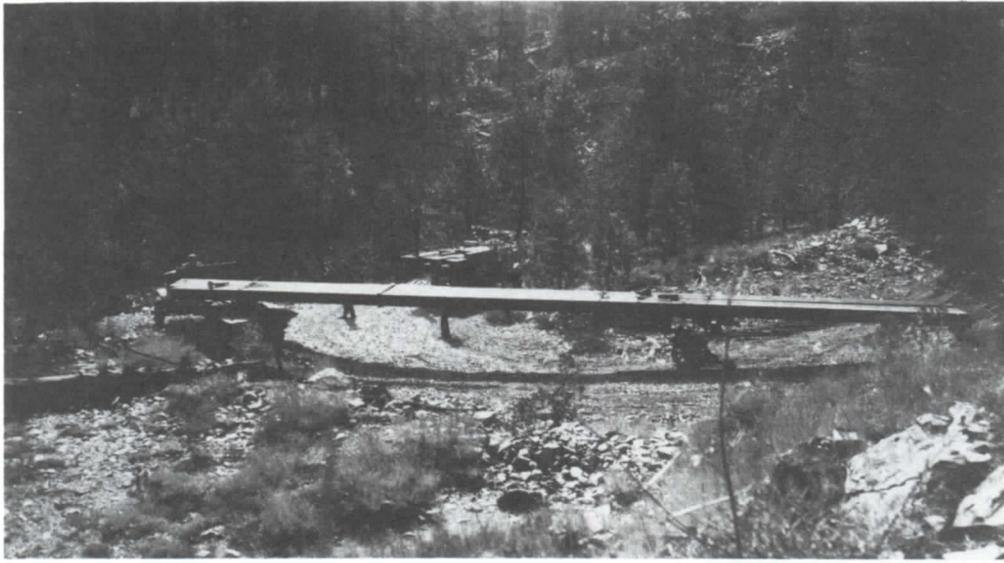
Our next job was reconstruction of a bridge across the Klamath River at the Horse Creek. This is the first time that I had to resort to a gantry crane to handle the dismantling of the old bridge and erection of the new one. The new bridge utilized all of the castings and steel removed from the old one. It was surprising the number of castings that were cracked and had to be replaced. The cracks were barely discernible. As a matter of fact, many of the cracks did not show up until we immersed the castings in kerosene.

A new bridge that had many interesting features was constructed across the Yuba River, at that time known as Milton Crossing. This bridge consisted of two 60-foot Howe trusses. Using heart structural grade redwood, the bottom chord timbers 14 inches square and 64 feet long were trucked to the site on two 5-ton liberty trucks. It was quite a tortuous road, and navigating the turns was a problem. I forgot to mention this bridge is on the Tahoe National Forest. En route to the bridge site, we had to travel through a lumber town. The mill manufactured only pine timbers. I recall the mill owner contacted Woodbury and protested all redwood coming into pine country. The protest was too late to do any good, except Woodbury requested that we not use redwood in typical pine country. There was another bad feature to the use of redwood. There were many porcupines in the area, and they immediately set upon the end posts of the bridge to chew the timbers, because of the salt.

In my hurry to get this narrative completed, I have forgotten to mention that in the fall of 1923, Fred Fowler left the Forest Service to go into consulting practice. He was replaced by a dynamic young engineer as District or Regional Engineer. This man's name was Frank E. Bonner. His specialties were Forest Highways and Water Power projects.

Perhaps I have failed to mention that in the early days and until the establishment of the Regional Office of the Federal Power Commission, the Engineers' office of the Forest Service made all of the investigations of projects proposed for power development by any existing or potential power companies in California. Forest Service Engineers examined proposed projects and applications for license to the Federal Power Commission for the project, if it were wholly or in part on federally owned lands. The Federal Power Commission occasionally detailed some of their engineers and accountants to work with the Forest Service in preparation of the final report on the project.

Frank Bonner soon found that there was a lack of sufficient data on possible power developments on streams in California. This started him on his investigation of power potentials on California streams, and preparation of his final report, which became a U.S. Geological Survey publication. It was entitled "Water Powers of California" and has served as a reference to engineers as to power possibilities on streams in California. The report was very comprehensive and included diagrams and profiles of streams that indicated existing power developments and future developments. I am sure



Milton Bridge. (This shows the difficulty of trucking 64-foot, 14-inch by 14-inch heart structural redwood. The switchbacks were difficult to negotiate.)



Milton Bridge across Yuba River. (This is a Howe truss bridge having a main span of 60 feet. The Construction Engineer was John H. Lawrence. This bridge caused considerable furor because it is constructed completely of redwood timbers, which were trucked through the heart of the pine country. Even T.D. Woodbury, Chief of Timber Management, was quite concerned.)

it is still considered the most authentic statement and estimate of the hydroelectric power potential of California streams.

I would like to add that his son, Jack Bonner, worked on my bridge crew for quite some time. All of the members of the crew, including the old timers, liked Jack because he wasn't playing around. The only complaint I have heard about Jack was that now and then he had nightmares that would awaken the whole crew. This is about the only time I can mention him. It is sufficient to say that he had engineering abilities because if I recall correctly, at the present time, he is Chief Engineer of the Pacific Gas and Electric Company and a Senior Vice President.

Now to 1938 and the Grand Canyon Bridge. I think the best way to introduce the subject and tell how I happened to participate in its construction would be to quote a letter from Frank Kittredge to the Chief of the National Park Service as follows:

*The Director
National Park Service
Washington, D. C.*

May 9, 1929

Dear Mr. Director:

Am enclosing copy of report covering the design and construction of the new Kaibab Trail Bridge across the Colorado River, which was constructed during the early part of last season. Am sorry this report has not reached you earlier, but there has been so much congestion, both in the matter of work for the engineers, and stenographic work, that it could not be gotten out on either account.

During my visit to the Grand Canyon in the fall of 1927, a very great need of a new trail bridge across Grand Canyon was expressed, not only by the Superintendent, but very definitely so by the Harvey people. Upon the recommendation of the Superintendent I immediately took up with your office this need; and, due to your very expeditious grant of authority to proceed, and set up of funds we were enabled to proceed almost at once with the design of the structure, and its ultimate completion before the heavy tourist traffic of the next season developed. The Harvey people, I am sure, are very appreciative of the Park Service's quick action in taking care of this need.

Taken as a whole, I think the report which has been prepared by Mr. Webber as Designing Engineer, and Mr. Lawrence, as Construction Engineer, conveys an excellent and comprehensive idea of the nature of the entire structure.

The designing of a trail bridge, 500 feet between supports, required the consideration of unusual elements. We were unable to find any record of any other trail bridge of equal length. The Forest Service has designed a great many trail bridges, but none of them that approached 500 feet—the usual run of bridges being between 100 and 300 feet. Furthermore, in the Grand Canyon we were confronted with a number of unusual conditions:

- 1. The bridge must be of sufficient strength to carry a pack train of any length, that is, a string of animals to completely cover the structure. On account of the possibility of inexperienced riders, tending toward congestion, it was*

necessary to design to take care of concentrated load, in case animals should stampede and congest at any point over the entire length of the structure.

2. The bridge must be rigid, in order to take care of a full string of animals without swinging or movement which would cause fear to the tourists.

3. At certain times the wind drives either up or down the canyon at terrific rate. I am told that the old bridge, upon at least one occasion, was turned completely over by the force of this wind. The new bridge must necessarily have sufficient strength and rigidity against transverse wind stresses to prevent its buckling in the middle. For a highway bridge of ordinary width, say 20 feet, design would be a simple matter, because transverse bracing in the floor system would be designed to take care of this force. With a trail bridge, however, only 5 feet in width, it becomes a very difficult problem, as there is not sufficient width to permit the installation of necessary bracing. This structural difficulty was taken care of, however, in part by special design of the transverse members, by the installation of heavy wind cables. It will be noted, from both photographs and plans, that the ends of the wind cables not only extend as far up and down stream as possible, but also are considerably below the elevation of the bridge; thus, not only is the pressure of the wind both upstream and downstream taken care of, but also the wind tendency to lift the bridge is counteracted.

We did not have anyone in the Chief Engineer's office who had actual experience in the erection of large steel trail bridges. The conditions at Grand Canyon were very unusual, not only because the material had to be packed on muleback approximately seven miles, but also because of the necessity of constructing between cliffs and over a very swift and dangerous river.

At our request the Forest Service very kindly agreed to lend us their Engineer, Mr. Lawrence, who had a great deal of experience in construction of their trail bridges, particularly suspension trail bridges. It is due to Mr. Lawrence's experience, ability, personality, and discretion that the project was put through without casualties and with such fine results.

A review of the photographs will indicate the danger in which all the bridge men worked much of the time. Photograph #45, on page 36, shows Mr. Lawrence, himself, as he was returning from one of the cable anchorage points, a position in which most of us would not think of getting into for the price of the bridge, or more—70 feet above the water and nothing but cliffs to hit on as you drop.

Many ingenious and cost saving devices were installed by Mr. Lawrence. One of the many features which led to the satisfactory and economical handling of this very unique project was the adequate and efficient delivery of steel and other materials to the bridge by the Superintendent.

Photograph #2, page a, shows the original cable anchorage of the first suspension bridge. The fact that the old trail had to be kept open for travel made it very difficult and expensive to work under them to place the new and more substantial anchorages. It was due to delays encountered on this account, and keeping the original bridge open to traffic, that more time was required than originally estimated.

In the designing of so long a span, which had to be made fairly rigid, it was impossible to place the new bridge at the same elevation as the old one. The new bridge was therefore placed approximately 15 feet higher than the original structure. This increased elevation threw trail systems at both ends out of elevation. At the south end it seemed best to construct a tunnel; and though

rather expensive, it completely eliminated all danger from falling rocks, avoided the necessity of overhang, and eliminated the danger of undermining the bridge cable supports; it also provided a straight approach to the bridge instead of a right angle kink, which would have been necessary with any open trail. The possibility of congestion, and nervousness on the part of timid tourists, is eliminated by the use of the tunnel. At the north end a bridge loop was constructed which provides fair curvature and a very safe and open trail.

By this system, danger of fright due to unexpectedly encountering persons or animals rounding the abrupt curve to the left of the bridge is entirely avoided. Furthermore, the loop is rather attractive in itself and gives the tourists an opportunity to gain a view of the complete structure which they have just passed over.

We think the solution of the routing problem at both ends of the bridge has been well taken care of. Resident Engineer Carroll, Superintendent Tillotson, and Bridge Engineer Lawrence are responsible for the satisfactory working out of this problem.

Very truly yours,

*F. A. Kittredge,
Chief Engineer*

I had built quite a few suspension bridges, but the Grand Canyon Bridge presented many problems that I had not previously encountered, among them being its location at the bottom of the Canyon, about 5,000 feet deep. Transportation facilities were by trail only. Power construction equipment was at a minimum, and the tremendous heat in the Canyon day and night caused about a 300-percent labor turnover. The men who would have could not stand the heat, which at times was so great that there was no relief even when the sun went down. The walls of the Canyon retained the heat.

Early in March 1929, I arrived at the Park Service headquarters at the Grand Canyon. I was followed shortly afterwards by some members of my Forest Service bridge crew, together with some of the Forest Service bridge equipment. As I recall, my bridge foreman was a foreman I had had on the Horse Creek Bridge on the Klamath. His name was Roger Flanders, a big rawboned chap who had previously been a chief mechanic for one of the gold mines in the Mother Lode country. However, the heat got him and he did not last very long. In his place I brought in W.G. Mitchell, who I have previously referred to, and he did a most excellent job as foreman.

I rode down to the camp, which had been partially established at the junction of Bright Angel Creek with the Colorado River, just below the Santa Fe Fred Harvey Station at Phantom Ranch. The trip was made by mule. I was riding Rastus, the Park Superintendent's mule. He was a good animal, but I could not get used to looking at his head and seeing two big ears standing up. I wanted a horse. As a matter of fact, when I left the Canyon I insisted on having a horse to ride out—I got one. It did not take long to establish camp, but shortly after we were there, a terrific wind came up the Canyon, which lifted our tents 2 to 3 feet in the air. The only way we could hold them in place was to tie the tent ropes to about a ton of rocks.

I recall one day seeing the wind whip a 50-gallon drum filled with water off a rock point just above the camp.

The Canyon was beautiful. The cactuses of many varieties were in full bloom, and the Canyon walls of varying colored rock emphasized the beauty of these cactus blooms. I thought it would be nice to have some of them for the mess hall tables and picked a bunch, not realizing until later that they would leave a variety of spines in my fingers.

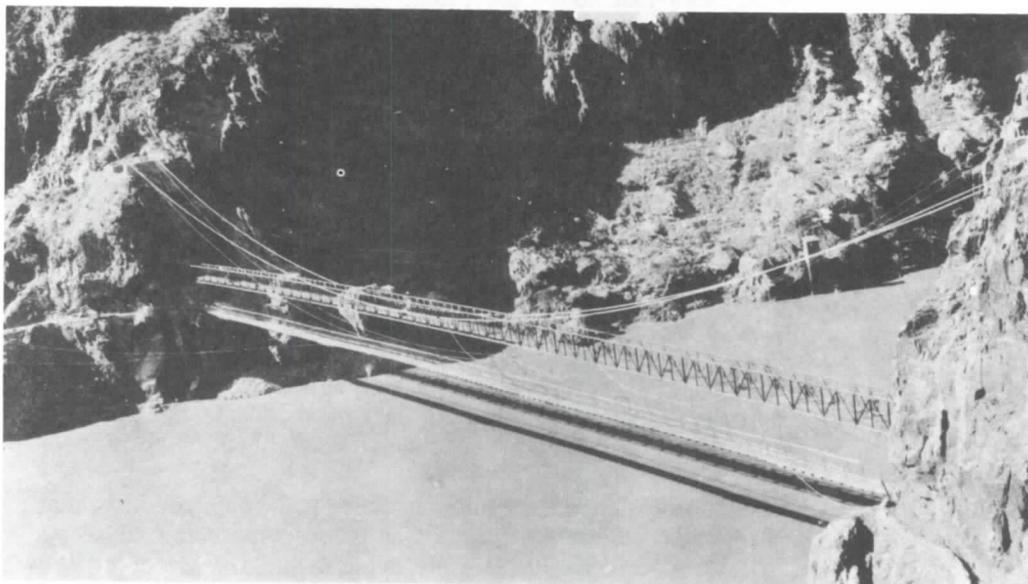
During March, until the first part of April, it was not hot, but later the temperature seldom got below 100°.

I believe that Mr. Kittredge mentioned that this was a trail suspension bridge of 500-foot span between cable supports. It was designed for a full bridge load of animals from end to end and further designed and placed to offset lateral displacement by terrific winds by means of hold-down cables, called "wind cables," secured to the underside of the floor system.

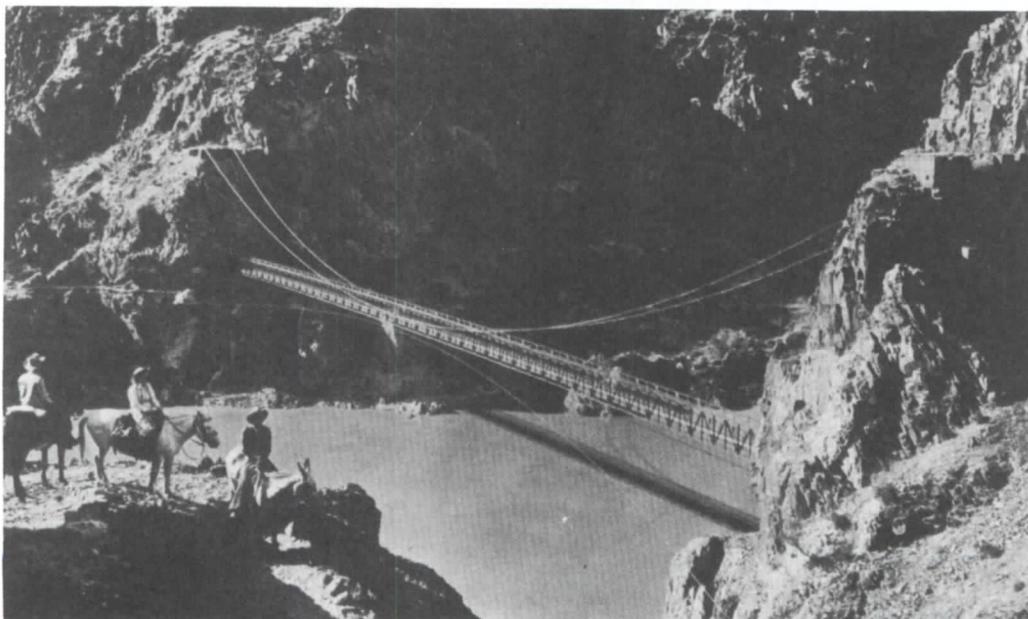
At the time I started construction, there had been no plans made for approach trails. Since the bridge was to be constructed 15 feet above an existing trail bridge, it was quite evident that we could not shelve into the rock cliff on the south approach, so we devised and planned a 105-foot tunnel 6 feet wide and 10 feet high, as I recall, with a trough in the center and a rock step on each side so that in case a rider had to dismount he would not have to worry about his animal crushing him against the tunnel sides.

On the north side, we constructed a spiral trail approach cutting the trail through solid rose granite. The tunnel was drilled through alternate layers of mica shist and rose granite. We had two 80-cubic-foot portable compressors, expecting to drill from both ends of the tunnel simultaneously, but soon found that we had hardly enough pressure to run one jackhammer, so on the tunnel construction we would drill in one portal during the day and blast, generally pulling about 4 feet. Then at nighttime we would drill from the other portal. Drilling and tunnel mucking turned out to be a long and tedious process. I recall being advised by a County Health Officer that goggles and respirators were required by Arizona law. I soon obtained this equipment, and we had no more complaints from the County.

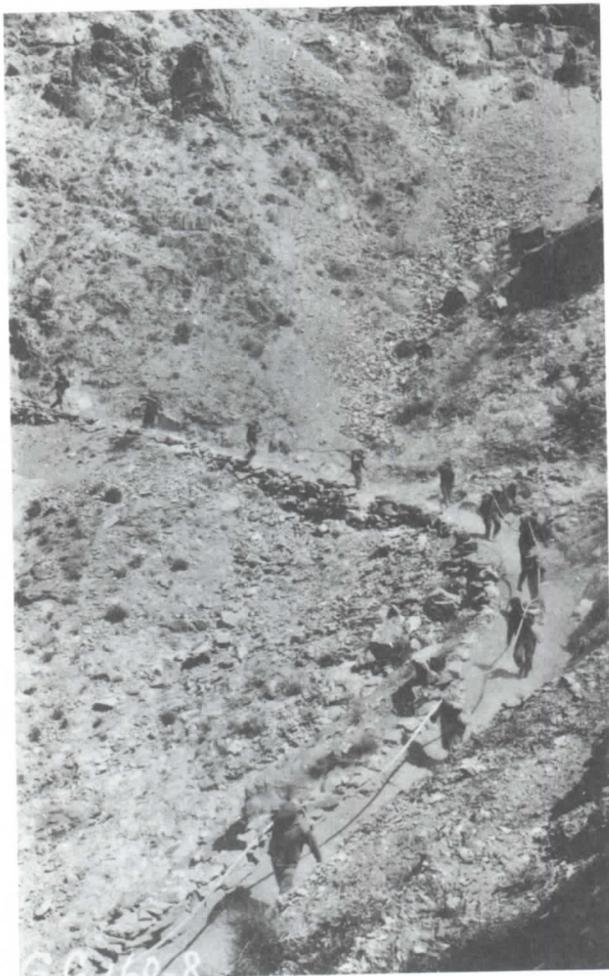
Meanwhile, we went ahead with the placement of the main cable anchorages and support saddles. There were four 1 1/2-inch-diameter galvanized plow steel bridge cables; each cable with bridge sockets weighed approximately a ton. These cables were each packed down to the bridge site on the backs of 42 Indians. Each man carried about 50 pounds, and they would make a round trip in 2 days. It was about 7 miles from the head of the trail to the bridge, with a drop of about 5,000 feet. It was an interesting sight to see these trips. The Indians carried their own food, and when they got to the bottom of the Canyon, after getting rid of their cable, they went on to a flat, gathered brush, made sort of a trench of it, and placed big boulders on the brush. Then they set fire to it, and after the fire died down, they spread their blankets over a wooden frame they had constructed, doused the rocks and live coals with water, and would walk through this tunnel of blankets getting steam baths and then jump into the muddy Colorado. I took a



Kaibab Trail Suspension Bridge across the Colorado River before removal of old suspension bridge, which was built in 1920 by M.R. Tillotson, National Park Service.



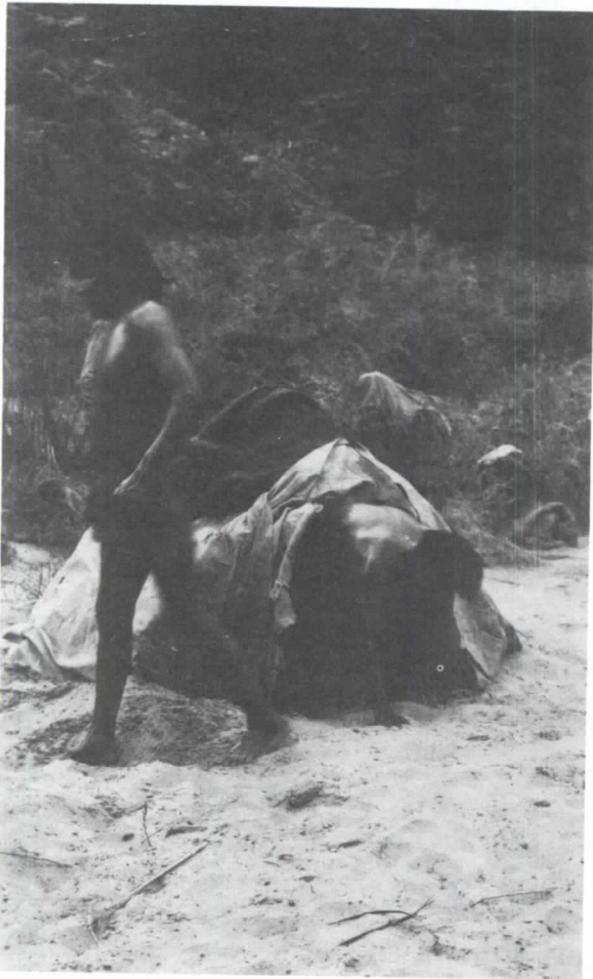
Completed Kaibab Trail Suspension Trail Bridge on Colorado, 1928. (Bridge has main span of 500 feet between cable supports and a 400-foot truss. Constructed by John H. Lawrence.



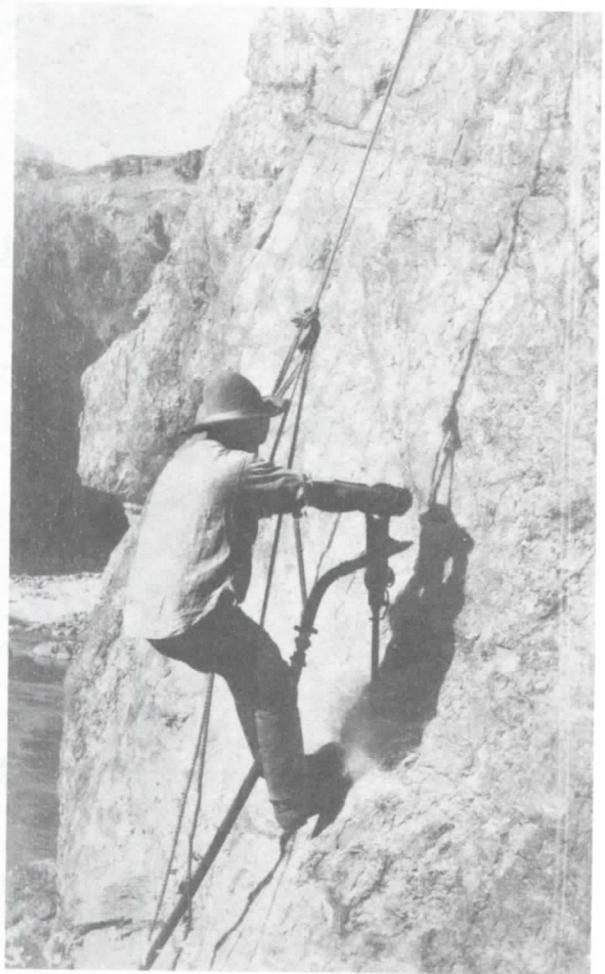
Kaibab Trail Suspension Bridge. (Forty-two men, for the most part Indians of the Havasupai Tribe—each man carried 50 pounds on his shoulder, 7-inch by 7-inch plow steel galvanized cable with little flexibility. As a consequence, going around some of these short switchbacks, an Indian or two at the point of the turn had to hold down the cable.)



Kaibab Trail Suspension Bridge. (Packing structural steel to bridge site on Park Service and Fred Harvey mules. Each animal carried a load of 250 to 300 pounds.)



The Havasupai Tribe, Kaibab Trail Suspension Bridge. (Chief of the Havasupai Tribe, who led the Indians packing the cable, permitted me to take this picture. This is included to show you that even 40 years ago, people knew about sauna baths.)



Kaibab Trail Suspension Bridge. (Drilling in the rose granite of the north abutment of the bridge. The rock was so hard that the jackhammer bounced more than it drilled.)



Kaibab Trail Suspension Bridge. (Lowering the next-to-the-last transom at the north end of the bridge. Since I had fired one of my riggers for getting the night shift tunnel crew drunk, I had to take over the job. My partner, Lee "Herc" Berriman. This is a picture of what I had previously called the "moment of truth.")



Inspection party at Kaibab Trail Suspension Bridge. (Pictured are: John H. Lawrence; M.R. Tillotson, Park Superintendent; Engineer Carroll of the Grand Canyon National Park; and Frank Kittredge, Chief Engineer of the National Park Service.)



Hauling cables on a "go-devil" to Kaibab Trail Suspension Trail Bridge site. (One horse and four men did the work of 42 Indians at a fraction of the cost of packing eight other cables.)

picture of one of these Indians—he was the Chief. Incidentally, the old timers used to say the Colorado was too muddy to drink, and too thin to plow.

This method of getting the cables to the bridge site was very expensive, so I had the Park Service up on top build a “go-devil.” The cost of getting the cables by this means was about one-eighth of the cost of bringing them down on the backs of Indians, but it took several days, and since we were pressed for time, transportation by the Indians was more expeditious. It required about 4 days to transport the coiled cables by go-devil. Also, large amounts of materials and supplies had to be transported to the bridge. The following might be of interest:

There are 67 tons of structural steel in the bridge.

There are 11,000 field rivets in the bridge.

The cost of packing the main cables down to the bridge site was more than the fabricated cost of the cables.

There were no serious injuries on this construction job, the most serious being a broken bone in a rigger's foot.

There was no piece of steel or other material dropped into the river.

There were approximately 122 tons of material and supplies packed to the bridge.

The new bridge will support all the live load that can be placed on it.

The high line used on the bridge was the cable that formerly carried traffic across the river and upon which Theodore Roosevelt crossed.

Not a pack animal was laid up from injuries received from packing the material.

The approximate breaking strength of each cable group is 360 tons.

For 2 full weeks there were seven packers, 42 pack animals, and seven saddle animals packing to the bridge every day.

It required 3 months to pack the main part of the bridge material and supplies and equipment to the bridge.

Our storage yard and areas for assembling and riveting were quite limited, as can be seen in the pictures that appear. Other pictures show transportation of the cables by the Indians and bridge steel by the pack train.

As I mentioned previously, due to excessive heat, there was about a 300-percent labor turnover, so the Park Engineer's office was kept busy supplying me with replacement labor. I recall one time I asked him to send me two tunnel muckers. They got down to the bridge one morning about 11 a.m., and I asked them if they were the tunnel muckers. One of them said yes, and the other said, “Well, I guess that's why they called us.” I

considered his reply and told him, "If you don't know, then go back up the trail." With that answer he said, "Give me a chance will you." I told him, "Sure, go to the camp and get settled." After lunch, one of the muckers came out and the other one did not. When I got back to camp, I asked him why he did not come to the job. He maintained he had hurt his back putting up his cot and making his bed. This bird had brought a rifle with him, which I immediately took possession of since no rifles were allowed in the Park. I broke the gun down and put it under my cot.

I learned later that night he engaged several of the bridge gang in a poker game and let them win. The next day he did not come out to the job, saying that he had wrenched his back, maintaining he thought he had. That night, I am told (I did not see this) that he engaged the same group in a poker game, and since they had won readily the first night, they gambled pretty high stakes. It was not until the game was over that one of the men fortunately found that he had been playing with marked cards and he had gotten quite a bit of the gang's money, including some Government checks. One of the bridge crew members was all for beating him up. He was a good sized man, and the poker player, being much smaller, suggested that he pick on someone his own size, so one of the smaller members of the bridge crew offered to take him on, but he scuttled back to his bunk.

The boys told me about this in the morning, and I fired him on the spot. I recall he asked me for his rifle, and I told him that it had gone up on the pack train and he could get it up on the trail. The packers and the bridge gang did not have much use for him. The packers would not let him ride on one of their mules, so the bridge gang put him on a burro, maximum speed about 1 1/2 miles per hour. I understand tunnel workers jeered him as he went by. About 2 weeks later, I got a call from the Sheriff of an adjoining county. He said they picked him up for attempted holdup and had found these Government checks in his possession. He gave me the names of the signers, and I found the checks had been given in payment of poker losses. There were other quacks who we had to let go, but he was the most colorful one.

A very handsome University of California student who had come down with my original bridge crew members made the mistake of getting the night crew on tunnel construction drunk. I could not tolerate intoxication on the job, so I fired him, much to his disgust. He had previously been one of my riggers, so when he left, I had to take the other rigging job myself. One time while sliding down one of the 3/8-inch hangers, which was our customary method of getting down to the old bridge deck, he made the mistake of looking down at the river and froze on the cable. It was all two of us could do to pry him loose and slide him down to the bridge deck. I was told later that he became a Navy pilot, and when escorting a plane carrying dispatches from Japan, he crashed into a mountainside and lost his life.

I would like to give credit to Edwin W. Kramer, Jr., for the excellent work that he did, suspended about 65 feet from a rock point, drilling openings for the wind cable anchorages with a jackhammer. This was a dangerous undertaking and required a level head. Ed was the son of Edwin W. Kramer, at that time Assistant District Engineer to Frank Bonner.

Now comes the moment of truth. I had, on numerous occasions, narrow escapes from death—this one was the narrowest. Having fired one of my riggers, as previously stated, I had to take on the job of rigging myself. If I had not had a competent foreman to keep the rest of the work progressing, I would not have been able to do this job.

In placing the floor system for the bridge, we riveted together several members of the floor system, which we called transoms. These were placed on a handtruck wheeled through the tunnel and stopped below the point that they were to be assembled into the floor system. Each transom weighed approximately 1,300 pounds. When the lifting tackle was attached to the transom, it was hoisted above its final position in structure. This was done with what they called a "six-part" line. That means that there were three sheaves on both the upper and lower blocks. Once the transom had been raised to sufficient elevation, the other rigger and I would secure the fall line to the lower hook of the tackle. It was then lowered to its final position in the floor system.

Incidentally, the other rigger working with me was a powerful young chap, the son of the District Ranger at Georgetown Ranger Station. He was also on the University of California wrestling team while at school. His name was Leland Berriman.

On this day, we both happened to look up and at the same time saw that the hook on the upper block was slowly opening up. It did not take long to size up the situation. We actually had no alternative. If the hook failed and the transom fell, and if we had grabbed the high line which was within reach, we would have been catapulted into the air by the backlash of the cable. We could not ride the falling transom down because we would have been dropped into the Colorado River, which was about 80 feet below, and undoubtedly been pinned down by the steel.

We were lucky. I had a large pair of wirecutter pliers, and he had a small coil of number 9 telephone wire on his belt. We quickly took several turns of wire around the opening hook, secured it, and lowered the transom to position. For a while, it looked like certain death; but, luck was with us.

As I recall, we never mentioned this incident to the rest of the gang, but I can assure you that after that time, every hook had adequate safety fasteners.

I find that I had not previously told you that just a short distance upstream from where we were building the bridge, there was a USGS stream gauging station.

Day in and day out, it was operated by Adrien Williams, later to become one of the leading hydrologists of the USGS in Washington. I believe he is still there.

And now for a bit of bragging. One day I was in a hurry to go to the top of the trail to transact some business at the Park headquarters. No horses or mules being available, I hiked. Someone timed me and found that I had made the 7 miles and 5,000-foot climb in 2 hours and 20 minutes. When Ade Williams heard of this, he remarked on the speed, and I recall telling

him that I could have made it in 2 hours flat, and I had bet with him that I could. If I won, I got a box of Hershey's chocolate.

So the next time I was in a hurry, I was in a hurry. They checked me out at the bridge camp just below Phantom Ranch and then at the top of the trail. I am sorry to say that the best I could do was 2 hours and 11 minutes.

About the last mile and a half was through decomposed granite so I had to jog through to keep from sinking to my ankles at each step. Needless to say, I lost the box of chocolate, but found I had established a record for hiking out of the canyon. As a matter of fact, years after the incident, I saw Park Superintendent Tillotson in San Francisco, who told me that many had tried, but none had equalled that record—which was gratifying and a good substitute for the box of chocolate. That's all for bragging.

On my return to California, some of the men I had picked up on the Grand Canyon project came to California to work with the bridge crew. I do not recall any outstanding bridge project in the balance of the year.

In 1929, we started the season building a bridge at the Forest Supervisor's headquarters at North Fork (Forest Supervisor was M.A. Benedict). The main span was a 55-foot low truss designed for H-15 loading. It was different from previous low truss designs in that all chord members were rolled sections. That is structural steel as it came from the rolling mill with such plates as required. The dead load for this type of construction increased the uniform dead load on the bridge by a small amount but was not sufficient to affect the economics of design. As a matter of fact, the structural steel, even though weighing more, cost less than what we normally used up for construction. The steel fabricators liked the design because it saved quite a bit of work making the shop plans and laying out the steel for fabrication. In the years following, we used rolled sections in all of our truss designs and construction.

We built a bridge across Hayfork of the Trinity River near the town of Hyampom. I will not go into details on this structure but will include a picture.

By this time we had hired several U.C. students on our bridge crew. It was good experience and training for them, and they sure produced many times the value of work that their wages cost.

They also produced some minor local disturbances. These young healthy boys were in conflict with the local swains of the girls. Many times jealousy flared to the point of almost animal combat.. However, it really never got to that stage because the bridge crew was a unit—all for one and one for all. If at a dance a bridge crew man was called out, several bridge crew members accompanied him. To my knowledge there were no actual fisticuffs, but there was plenty of talk. I think the local boys were glad to see the bridge crew leave for another job.

One time they were going to have a dance at Hyampom. Naturally, the bridge crew was invited. It was an open-air dance floor, being the floor of a barn that had been torn down. It was polished to smoothness and dancing

quality by dragging bales of hay repeatedly back and forth. The dance started at sundown and lasted until sunup. The evening the dance was scheduled, I had heard that a local bootlegger was driving a pickup truck down to Hyampom to supply some of his very inferior bootleg whiskey. I remembered telling some of the boys that I did not like the idea and thought that he should be prevented from supplying the dance. They took the hint. The bootlegger never did get to Hyampom with his load of whiskey. Some place along the way, the boys had interrupted his progress and turned his load down the mountain.

In my hurry to complete this narrative, I have overlooked mentioning several people who made very important contributions to Engineering activities. In 1923 or 1924, Frank Bonner appointed an engineer by the name of Bruce B. Burnett to head up Forest Highway activities, planning, and discussions with the Bureau of Public Roads. Burnett's previous work with the Forest Service had been as a timber scaler on the Eldorado Forest under Supervisor Edwin (Lassen) Smith and later on as a topographer in the Surveys and Maps Unit. Previous to his Forest Service experience, he had constructed highways in South America, and had received high commendations for his work.

The Bureau of Public Roads did not feel that any agency, except their own, was qualified to design and construct highways or roads, and there were many acrimonious discussions as to locations and standards of projects. As a matter of fact, the Forest Service, if they constructed a Forest road, had to call it a minor road, and even then it was subject to criticisms by the Bureau.

Each year there were Forest Highway meeting to determine the program for the coming year. These meetings were attended by the Director of Public Works, the State Highway Engineer of the State of California, the Chief of the Western Branch of the Bureau of Public Roads and his assistant, the Regional Forester, at that time District Forester, the District Engineer, and Burnett. It was quite difficult for the Forest Service to get projects that they deemed necessary approved, since the Bureau and the State were generally in agreement as to what the program should be.

Bruce was a capable and dedicated man, and was reluctant to yield on any projects that the Forest Service had proposed. This condition improved in later years, but it was quite a problem to get an adequate Forest Highway program satisfactory to the Forest Service. Bruce Burnett was the father of transportation planning in the Region.

He had several able assistants, including Nick Strawn, George Newhall, Giles (Mac) McHenry, A.W. (Wally) Lund, and Nelson Salmon. I always considered Mac as an anchor man. In any undertaking in which he participated, you could always depend on him.

Nelson Salmon was with the unit a short time. He was an officer in the Naval Reserve, and shortly after Pearl Harbor, he was called to active duty and assigned to a cargo transport vessel. When he got into the war zone, his ship was attacked by a Japanese suicide pilot, who plunged his plane onto a foredeck of Nelson's ship. I think they call them "kamikaze" pilots. Acting very quickly, Nelson lowered a boom and swept the plane into the

ocean. By this act, he saved the ship from possible destruction by fire with the attendant loss of many men. Wally told me just recently that Salmon had been promoted to Captain in the Naval Reserve, a promotion well deserved.

The procedures for determining what should be included in the plan were generally originated by Bruce, and transportation planning, as practiced in the California Region, was generally accepted throughout the Forest Service as the way to go about the job. This transportation planning was applied Forest by Forest, and approval of individual Forest transportation plans set up a well-thought-out need for Forest road construction, and was very valuable in setting up a program for road construction during CCC days.

About the time that the CCC program started, the designation of these roads was changed from minor roads to truck trails, in another attempt to ward off further criticisms by the Bureau of Public Roads.

Bruce Burnett had another big job, which he carried on for 2 or 3 years. He compiled a voluminous, well-illustrated, and documented report on Forest Highway Systems in California. It was used as an authoritative treatise on existing and potential Forest Highway needs. It was a volume about 4 inches thick, but was never published. Another thing that, I am sure, he started, was a plan for special highways in the front country of the Sierras, called "The Sierra Way." It was a well-conceived plan to tie the Forest together with a high-speed highway.

Another Engineer who contributed much in his early days with the Forest Service toward the survey and design of the minor road system and very important much later when the CCC program got under way was Charles L. Young. You will hear more of him later. In the early days, he worked under the direction of Chester Jordan, who, as previously stated, was in charge of minor roads, trails, buildings, telephone lines, and other improvements.

Still another Engineer who deserves considerable recognition for the work that he did in developing a modification of the conventional bulldozer was Earl Hall. I believe that he was previously an engineer with the Cletrac Tractor Company. His job was to design a machine on which the blade could be adjusted to any desired vertical and horizontal angles. This was an idea of his own. Since he did not have any plans or specifications, he designed the machine piece by piece, by cut and try method to achieve the desired result. He did most of his work at Government Island, which was the headquarters for the Bureau of Public Roads' repair and mechanical shops. This depot was under the supervision of Capt. Ambrose Brown, who assisted Earl in manufacturing the various parts required for the pilot model.

The machine performed just as planned, desired, and expected, and after some modifications by Earl, the final plans were prepared by Howard Jones from the machine itself. Jones later became Regional Engineer at Missoula, Montana.

I have often wondered why someone did not take action to obtain a patent on this machine in the name of the Government and Earl Hall, which would have allowed him to collect money from anyone purchasing these machines,

except the U.S. Government, many of which were made later. Earl might well be a rich man at this time if such a patent had been obtained. Needless to say, hundreds of these machines were purchased by the Forest Service for the CCC program.

I would make mention of a happening which was greatly to my benefit. Frank Bonner, without any previous word to me, arranged to get me professional engineering status shortly after the completion of the Grand Canyon Bridge. From then on my progress was very satisfactory. Frank Bonner was a man who was always finding ways to assist his subordinates in furthering their careers.

This was the year that we constructed many bridges using rolled sections instead of built-up members. The first bridge was a 75-foot truss across Coffee Creek above the old town of Carville. There was nothing unusual about the construction. It was on this bridge that Hamilton K. Pyles began his career with the Forest Service as a day laborer at \$3.50. We all know where he finally ended up in the Forest Service. To a large degree, his progress was due to an insatiable curiosity of what made things click, and his ability to follow instructions. You will hear much about him later.

Another newcomer was Robert Condon. He too was a good worker, a good talker, and also a good baseball player. Unfortunately, he broke his wrist in a baseball game in a cow pasture at Carville. He was playing second base for our bridge crew team. He did not remain with the bridge crew for any length of time, but his talking ability eventually got him elected as a representative to Congress from Contra Costa County.



Coffee Creek, Shasta National Forest, 1930. (This is a steel Warren truss bridge having a main span of 75 feet. The Construction Engineer was John H. Lawrence. This bridge is the first bridge that "Ham" Pyles worked on 38 years ago. He was employed as a laborer at \$3.50 per day.)

One incident might be of interest. At the Carville Inn, there was a California coed working during her vacation as a waitress. I failed to mention that Ham Pyles was a student at the University majoring in anthropology. One night, we were having an informal dance at the Inn, and the coed and Ham Pyles went on a trip to Redding, to the dismay of a husky local boy who apparently was enamored with the girl. The young chap became somewhat belligerent, so we decided to quiet him down. Lee Berriman, who was my partner in the previously stated moment of truth, challenged him to some Indian wrestling. They were pretty well matched physically. I took on the job as starter—at the count of three, each was supposed to try to throw the other's arm to the table. I don't think I have to mention what Indian wrestling is. It is sufficient to say that Lee Berriman beat the local boy on all three tries, much to his chagrin. So, Lee Berriman, trying to make him feel better, told him, "Don't think nothing about it—the boys all call me 'Herc'." He wasn't bragging; they did.

I failed to mention that in 1929 I picked up two men while constructing the bridge at North Fork. They became very important members of the crew. One was an expert carpenter named Chet Lockwood. He was about 5 feet, 2 inches tall. The other was a chap named Mortenson, who I promptly nicknamed "Shorty," because he was only 6 feet, 7 inches tall. He had been one of the team of champion timber fellers in World War I. While on the bridge crew, he served as a rigger and steel worker. He was doing a mighty good job at both, except for the times when there was a run of fish under the bridge. He just could not stand fish that weren't being caught.

I have also failed to mention that we had acquired two truck drivers for the old Army Liberty trucks. They were Walter and Rix Sorraco, both able truck drivers on these big trucks, which had inadequate brakes for driving on mountain roads. As a matter of fact, most of the time to bring the trucks to a stop, they would have to put two wheels on one side of the truck in the ditch.

Nineteen thirty-one started out with an assignment to check the safety of an old suspension bridge across the Trinity River at Hawkins Bar. The reason for the safety check was to be sure that the bridge would withstand trucking parts for a new Forest Service power shovel across it. I think it was a Thew-Lorraine.

I checked the bridge pretty thoroughly, particularly at the quarter points, which were the points of maximum stress in the stiffening trusses. They checked out with a safety factor of 2.5, which was sufficient to justify the use of the bridge in transporting the shovel parts across the river. I also checked on most of the bridge stringers.

The last load to be trucked was a 5-ton counterweight. I was very much concerned to see that they had loaded this counterweight so that all the weight was carried on the rear axle of the truck. I should have required that they shift the load so that at least one-fifth would have been on the front axle. I followed the truck as it crossed the bridge, listening to the creaking and groaning of the stringers as the truck crossed.

I was quite concerned that a son of Wilbur Huestis had jumped on the back of the truck, and I yelled at him to get off. Wilbur Huestis was the

foreman for the road to be constructed on the north side of the river. I was glad to see the last load proceeding safely, but he made the mistake of asking the truck driver to stop so he could get a picture. The stringers could not stand this steady concentrated load, and the last panel of the bridge failed, dropping the truck, driver, load, and Huestis' son about 30 feet to a rock ledge near the north tower. The counterweight landed directly on young Huestis, and he was dead before we could get him from under. The truck driver escaped without injury, but the truck was pretty well demolished. So that was a bad beginning to an otherwise good year.

Our first job was to replace all of the stringers in all bridges. We followed this with the construction of a 250-foot suspension bridge across the Trinity River at Big Bar and a 275-foot suspension bridge across the South Fork of the Trinity at Hyampom. On the Big Bar bridge, we expected a little difficulty since we had to keep the old bridge open to traffic while constructing the new one, since the Big Bar Post Office was on the south side of the river. Other than this difficulty, we had no trouble constructing this bridge.

The steel towers for the bridge and for the Hyampom Bridge were somewhat unique in that the bridge portals were formed into gothic arches, which gave a very pleasing appearance and also were structurally good design since the stresses through the arch carried down directly through the base of the tower. The steel fabricators remarked on the design and told me that it would not cost any more to fabricate these arches than it would have the conventional straight line design.

It was while we were constructing this bridge that I received a call from the Forest Supervisor, Millard Barnum, requesting the bridge crew to report to a fire 75 miles distant. The main fire camp was located near a small community called Del Loma. When I got the crew there, Barnum, knowing that I did not mind hiking, asked me to take a trip around the fire line and take with me the local bootlegger, so that he would not be available to sell his wares to the predominantly Indian fire crew. So, I started with him just about dusk and hiked clear around the fire, which required quite a bit of climbing to hit the top of the main ridge. There were three secondary fire camps on this line—we visited all, had a bite to eat and had some coffee, and landed back on the highway just after dawn. I am sure that the bootlegger was sufficiently tired that he would not be able to operate for some time the following day.

I am sure that Barnum will remember this instance. For those of my readers who are not familiar with firefighting, in those days, it was all hand work. No tractors or bulldozers available. We would cut and dig a fire line just as close to the going fire as we could work. If the fire broke over the line, we would drop back and build a line under the slop-over. I do not recall of hearing of any fatalities on any fires due to this method of firefighting. Of course, it would not work in southern California or in heavy brush areas.

I do not recall just when Frank Bonner left the Forest Service to become the Executive Secretary for the Federal Power Commission in Washington. He was replaced by Ed Kramer, and Kramer's assistant was John C. Beebe, a very able man, who had previously worked with the Army Corps of Engineers and the Nevada Irrigation District.

Ed Kramer was an expert mathematician. As a matter of fact, I think that he made a review of stresses in certain constant angle arch dams, which was a monumental undertaking for which he received much credit. I think he even prepared a paper on it for the American Society of Civil Engineers.

Ed did not have too much trust in subordinate employees. When he heard that we were going to have to revise the plans for the Hyampom Bridge and still build it within the funds allotted, he seemed afraid that I would fudge on the excavation for the anchorages, so he sent John Beebe up to see that I did the job right. When Beebe arrived, he told me just why he was there and asked to see what I planned to do on the excavation. I showed him my plans, which he readily approved, but since he was supposed to stay there until I had the excavation completed, he did, but told me not to bother him because he had some things he wanted to do. When my excavation was completed, I was to let him know and he would go on his way back to San Francisco. The bridge was completed without any particular difficulty, and according to the plans and specifications.

It was while we were constructing this bridge that Shorty Mortenson discovered a bee tree, so he decided to rob the tree of the honey. One evening just about dusk, he went out with a couple of smudge pots and drove the bees out. He then proceeded to cut out the honey, which filled a big galvanized washtub. The honey was sweet, and the old honey, which was almost black, was bittersweet. Sufficient to say that we had honey for many days, and the poor bees had to do the job again.

It was during 1931 that the bridge crew had developed a real baseball team. I will not mention all the players, but we had a catcher who was a civil engineering undergraduate at the University of California in the wintertime. He was quite a character. His name was David May, and he grew a heavy black beard similar to the ones worn by House of David members. He had such a good throwing arm that he could return the ball to the pitcher with more force than the pitcher would through the ball to him. His throwing to second base was just a toss to him. We played all of the local teams, and won all the games. I remember one time the umpire made a poor call, which Dave May did not like, so he pulled the rule book out of his pocket, showed the umpire where he was wrong, and, believe it or not, the umpire reversed the previous call.

To wind up 1931, we started to build a road suspension bridge across the Rubicon River. The approach roads had not been completed. As a result, we had to move all of our manpower, equipment, and materials by high line. The high line was 1,300 feet long and the vertical drop to the river a little over 300 feet. We picked up a new member for the crew at Hyampom, by name, Lawrence Madsen. We sure gave him a workout as a rigger on the Rubicon River project. We let all the materials out on the high line by gravity to a point on the cable for changing tackle to let the load down to the bridge site. It was Madsen's job to sit out there on the high line to secure the tackle for the letdown. He had to sit out there all day long except time out for lunch, and there are very few men who would envy him this particular job.

We had to stop work on the bridge because of bad weather and pick up construction the following spring. We completed the bridge without

incident. I was very happy when the last load was brought up and all men safely on the hilltop. We did not have sufficient money in our allotment to afford much-needed cables, and it was a constant worry as to whether they would hold up for the construction completion.

From this project we went to two other bridges on the Eldorado, the first one being a 75-foot truss on Camp Creek. The construction did not present any great problems; however, two things of note happened. First, one time at supper, my bridge foreman presented me with a watch that the crew members had bought. Naturally, I should have told them that such a gift was not permissible, and I would have if I had known about it beforehand. So to repay their thoughtfulness, I told them that their wages, beginning the following Monday, would be reduced by about 10 percent. If you would recall, this was President Hoover's economy move, but it did not prevent the depression that began in the following year.

The other item was an accident to Ham Pyles. Incidentally, his friend Bob Condon gave him the nickname of Hamilton Knickerbocker Peter K. Pumpkin Pyles. In line with my desire to be able to do any job that the crew members could do, I took over the job of running the rivet gun for a couple of days. Ham Pyles was my buck-up. Everything went along very well, until for some reason the rivet snap slipped out and hit Ham right on the forehead. It did not knock him out, but it did leave a nasty cut on his forehead. I bandaged it up as best I could and the following day insisted that he go to see a doctor in Placerville. The doctor said the wound was properly taken care of and there was nothing that he need do. I think he could have examined the wound more carefully because undoubtedly there was a piece of metal concealed in the wound, as Ham carried a lump in his forehead for a long time.

The next bridge was at a crossing called Pi-Pi, and we spent Thanksgiving of that year down at the bridge site. It grew so cold that we had to keep fires burning all night around the forms containing freshly placed concrete to keep it from freezing.

Now for 1933. This was the year that the CCC program started. Prior to the beginning of this program, early in the year I was sent down to Glendora to construct some experimental dams for the California Forest and Range Experiment Station. There were three dams in each of Bell and Fern Canyons. They were designed and instruments were to be installed to measure streamflow and siltation. My assistant was a young Engineer named John S. Cotton. He had worked with John Beebe on the Nevada Irrigation District program, a very capable man and an expert designer. As a matter of fact, I felt that some of his designs, although correct, were carried out to such a fine point that it was very difficult for labor to place concrete in some of the forms. They were so thin that it was hard to tamp the concrete. Later on, Cotton designed and supervised construction of other dams in the southern California area. These were practically all arch dams of rock construction. They were thin arch dams. The results were very successful since placement of the rock in the dams, and that being arched and planned, it was not too difficult to construct them.

I think it was in February of that year, while we were seated at the dinner table at Glendora, that the Long Beach earthquake struck. There were radio

calls for emergency help in the stricken area so we got in the pickup truck, put in our first aid kit, and drove to Long Beach. Although we got to the heart of the distressed area, we did not have an opportunity to use our kit. It was quite a shambles, and the quake was still going strong when we left to return home. Several times as we drove along, a section of the highway in front of us raised up and sank back. There was near panic when word was spread around that there was a tidal wave coming, but it did not materialize. The Navy had taken the precaution to move all of their vessels out of the harbor.

I am a little ahead of my story. At the time that the construction of these dams was initiated, Dr. W.G. Loudermilk was in charge of Watershed Research for the Experiment Station. The Station did not have too much money with which to construct these projects, and so Dr. Loudermilk and I drove to Los Angeles with the idea in mind of trying to get some public-spirited contractors or municipal agencies to loan to us some of the construction equipment required. We had no luck.

It was quite a thrill to ride with Dr. Loudermilk. Having been in China for years, he must have developed the habit of driving on the wrong side of the highway. We had several narrow escapes, but it did not seem to bother him at all.

A short time later, he was transferred to another Federal agency, and Charles J. Kraeble took over in his place. More about Kraeble later. If I recall correctly, Dr. Loudermilk later became Chief of the Soil Conservation Service.

In March or April of 1933, the Civilian Conservation Corps was established and things began to hum. Now there was no shortage of money or manpower for Forest Service construction projects. I was called back to San Francisco to organize and equip five bridge crews.

Civilian Conservation Corps

During this period, there were so many activities connected with the Forest Service construction under this program that I will report them in several categories. They will be:

- (1) General
- (2) Bridges
- (3) Mud Creek Project
- (4) Ponderosa Way
- (5) Mono and Caliente Dams
- (6) Truck Trail Locators

General

The Civilian Conservation Corps program was based on the establishment of camps of 200-man strength, the men being recruited from unemployed boys all over the country. The CCC programs are undoubtedly known to all my readers. The camp tentage, mess hall, and headquarters were set up by an

advance "cadre" furnished by the Army. The camp commander was generally a captain in rank, and his principal assistant was a sergeant. The cooks were also furnished by the military. The Army was responsible for feeding, housing, and general control of the men.

The work force was headed by a civilian camp superintendent who assigned the men in groups to the various work projects.

In the early days, there was considerable confusion as to authority of the camp commander and the camp superintendent. Sometimes it resulted in considerable disruption of the work program. Recognizing the possibility of these conflicts, the Forest Service and the Army each designated one person to represent its agency; for the Army, to start with, it was Major McCrystal; and for the Forest Service, it was none other than the grand old man—Chet Morse. The two of them did a wonderful job of settling disputes and conflicts, in most cases, without reference to higher authority.

With the advent of the program, a tremendous burden was placed on several divisions besides Engineering, the principal one being the Division of Operation, so ably headed by Bob Deering. Since the budgets were constantly changing, he got a very able assistant named Linné Alhberg. It was fantastic to me how he could keep track of changing budgets and situations. A heavy burden was also placed on the Supply and Purchasing Unit of Operation. The only simple thing in the whole setup was that it was not difficult to obtain funds to pay for personnel, equipment, and supplies and miscellaneous items. The Forest Service Supply Depot, originally at Ogden, Utah, was transferred to Government Island, originally under the leadership of Frank Haney, and later Mrs. Iva Mae Stevens took over the job and handled a most difficult job very successfully.

Bridges

As I stated previously, when I returned to San Francisco from the Experiment Station project in Glendora, I was told to organize and equip five bridge crews, prepare the necessary plans and specifications, recruit the supervisory personnel, and get the show on the road. Fortunately for us and the program, there were many qualified engineers and foremen available because of reduction of project work by power companies.

The supervisory force of each bridge crew was made up of an Engineer, who was in charge and at the grade at that time of P-2, Assistant Engineer. I think the salary was \$2,600 per year. He had with him a chief foreman, carpenter foreman, steel foreman, and a concrete and labor foreman. At times, this organization was increased or decreased, depending on the magnitude of the job to be done.

It was with quite a feeling of satisfaction that we were able to purchase for each crew adequate new equipment, including compressors, concrete mixers, hoists, and miscellaneous equipment. It was fortunate that we had the bridge surveys previously referred to, so that we could proceed with designs of many structures without further survey. We organized two bridge survey crews for projects on which we had no previous information. They were headed by two very able men; the first one by Norman Boyd Bailiff, who in later years became a registered land surveyor in California and is in business on his own; the second was J. Warren Nute, a tall lanky *laconic but capable*

and very pleasant chap who at the present time is County Engineer of Marin County.

The first project to be constructed under this program was the Happy Camp Bridge across the Klamath River. The Engineer was H.P.M. Birkenbine, a former City of San Francisco Water Department Engineer, known to Ed Kramer. The bridge was to be a 300-foot suspension bridge using the same gothic tower designs used on the Big Bar and Hyampom Bridges. This bridge and all other bridges on this program were designed for H-15 loading. It replaced an early-day suspension bridge that had no stiffening truss and could not safely carry more than a 5-ton load. The new bridge served quite adequately until the demands for lumber, because of World War II, required its replacement by a two-lane bridge of heavier capacity to carry the logging trucks transporting timber from the Indian Creek area to Happy Camp.

The second bridge was a 160-foot suspension bridge across the Sacramento River at Sims. The Engineer was a chap by the name of E. Raymond Huber who is probably well known to all of you. He was a man excellently qualified for this type of job. He later proved that he was qualified for more important jobs. His engineering design and construction, together with his ability to get men working together under difficult circumstances, proved his top quality. For those who do not know Ray, he later succeeded me as Bridge Engineer, then went on to the flood control project in Arroyo Seco Canyon, then for experience on general Forest engineering to the Shasta-Trinity National Forests, under the Forest Supervisor Norman J. Farrell, now Chief of Fire Control for Region 5. He was then promoted to Regional Engineer of Region 3 at Albuquerque, New Mexico. I am reciting this because, knowing Ray quite well, I feel that he may be a little too modest to recite such a history of achievements.

Ray fortunately had with him, as steel and general foreman, a chap by the name of Ham K. Pyles.

Before proceeding with this, I would like to mention that the men (that is, the CCC boys in the camp building the Happy Camp Bridge) were recruited in New York. Most of them had never seen big timber, and the double-bitted axe was a strange weapon to them. I believe there were quite a few minor accidents until they got accustomed to the fact that the axe would cut in two directions.

Now, back to my narrative. The Sims Bridge was constructed close to the mail line tracks of the Southern Pacific Railroad in the Sacramento Canyon, and it required continuous caution to prevent accidents on the railroad right-of-way.

Camp superintendents and commanders were constantly looking for athletics and other forms of entertainment for the men in camp. Ham Pyles took over the job of conducting boxing activities. He helped several promising youngsters in this respect and without too much difficulty floored several who were very aggressive or thought they knew more about boxing than he did. I failed to state that Ham got his boxing experience in Africa where, I believe, he entered several contests.



Happy Camp, Klamath River, 1933. (This is a steel suspension bridge having a main span of 300 feet. The Construction Engineer was H.P.M. Birkenbine. This picture illustrates the gothic arch construction used as a portal frame on the towers.)

The third crew was sent to the Trinity Forest to construct a bridge across the North Fork of the Trinity River. The Engineer was Al Simpson. I think he had also previously been employed with the City of San Francisco. He stayed on the Forest constructing several bridges and made a name for himself singing in local groups. Then he was transferred to the Shasta-Trinity as Forest Engineer. His later assignment was in the Regional Office Roads and Trails Branch.

The fourth bridge crew was assigned to the Sierra Forest. The Engineer was John Phillips, an ex-PG&E foreman. He built many structures on the Forest, both bridges and dams. He was an expert on concrete, and any concrete work turned out under his direction was bound to be flawless.

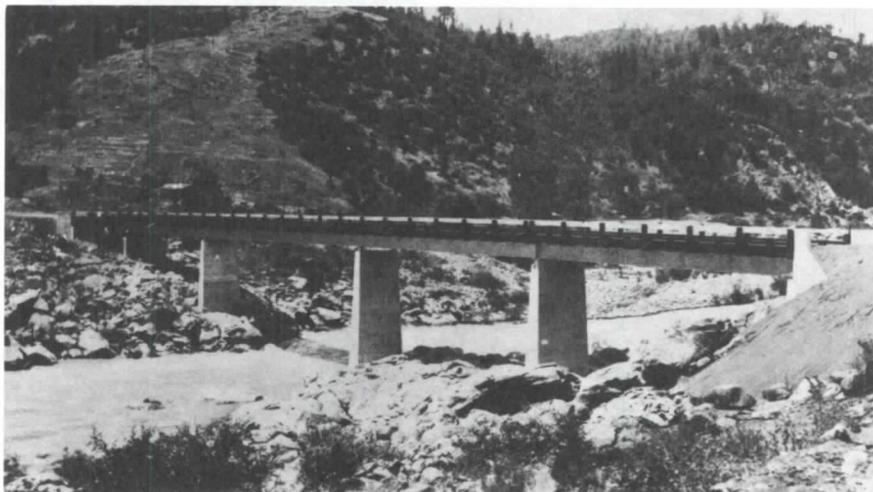
The fifth bridge crew was assigned to the Tahoe National Forest. The Engineer was William L. Minaker. I recall that I had difficulty persuading Ed Kramer to put him in charge of bridges in that area because Ed did not think that he had the type of personality that could accomplish construction under difficult circumstances and with inexperienced personnel. Bill

Minaker quickly proved how wrong Ed was. He was the first of our bridge engineers to construct a continuous beam bridge, which he did at Rice's Crossing (Yuba River). More about these continuous beams later. As many of you know, Bill Minaker progressed very rapidly in the engineering field of the Forest Service, worked on bridges, dams, and heavy building construction. At the time of his death, he was in charge of the Structures Branch in the Regional Office.

To prepare the necessary plans and specifications for the bridges on the program, I acquired several assistants: one of them, Norman W. Mohr, who was formerly City Architect for San Francisco; Ed Meldrum, later to become one of Jim Byrne's engineers on the "Emergency Rubber Project" at Salinas;

Harry Langford, who later became structural engineer at Region 2 at Denver; and Neil Meadowcroft, a graduate of Stanford University in sanitary engineering, but a well-qualified engineer on any type of design (more of him later).

It might be well at this time to say that for a long time, I had been contemplating the use of continuous beams where foundation conditions were good and where erection problems on conventional designs were difficult. Any design engineer knows that a continuous beam bridge throws the greatest moment on the piers. In other words, a concentrated load in the middle of the main span will cause an uplift force on the abutments and the heaviest



Rice's Crossing, Yuba River on the Ponderosa Way, 1934 or 1935. (This is a continuous beam bridge having a main span of 90 feet and two 60-foot side spans. The Construction Engineer was W.L. Minaker. This was the first bridge designed and constructed using continuous construction. A considerable saving in steel tonnage results from this type of construction. To the best of my knowledge, this was the first continuous bridge built in California where the foundations were on good solid rock. There was no difficulty with settling and distortion of the steel.)

moment on the piers. This permits reduction in size of the main span members and affords a considerable economy in construction. Old textbooks did not favor this type of design. It seemed that the principal concern was settlement at one of the supports. Theoretically, a settlement of less than an inch would overstress the steel in the beam. Fortunately, most of our continuous beam bridges were constructed on solid rock foundations. There was one instance where we used a continuous beam-type bridge construction for the approach to the Junction City Bridge on the Trinity Forest. This bridge was constructed under the supervision of Frank W. Thornberg, who later was assigned to the Regional Office Bridge Section. Heavy rains and high floods washed out the foundation of one of the piers supporting one of the main spans. As a matter of fact, one side of the pier was hanging from the continuous beam. The beam was deflected, but did not fail. As a matter of fact, light traffic continued to use the bridge until we provided new supports.

It soon became apparent that in order to keep up with road construction we would have to have more bridge crews. So we recruited five more crews, which were at points where a bridge was required to facilitate road construction. I will not go into details as to locations where new bridge crews were assigned. They were constantly changing as new construction was completed on the going project.

Ray Huber's third project was the construction of a continuous beam bridge across the Eel River at Gravelly Valley. The construction presented quite a few problems because steel beams 50 feet long had to be hauled from the railhead at Ukiah over narrow roads with many short radius turns. Also, the north abutment had to be constructed on very unfavorable foundations. The foundation was in a blue slide area, which was constantly moving.

One day, I visited Ray's project to see if there was anything I could do to help him. I stayed at his camp overnight, and the next morning I got my first introduction to an electric shaver. Ray had one powered by a 12-volt automobile battery.

That morning I decided we should go north to a trail bridge being built across the Balm of the Gilead Creek. In the northern end of the Forest, out from Covelo, we got two horses at Ham's Station and rode to the bridge site, a distance of 26 miles. The bridge was being constructed by J. Warren Nute. As things were progressing satisfactorily, we rode back to Ham's Station and drove back to Ukiah. Ray went back to Gravelly Valley from there, and I continued on to Berkeley, arriving about 2 a.m. I mentioned this because it was quite a trip for Ray to make on horseback since he had not ridden much previously. It sure showed up his intestinal fortitude that he could take this ride without complaint. Fifty-two miles a day is a good ride for an experienced horseman.

It was shortly after completion of this project and a bridge across the Bear River on the Tahoe Forest that Ray came into the office as my assistant. We had acquired a very capable Engineer by the name of Chesley G. Ferguson. He organized and kept current records of bridge equipment, its location, and prepared requisitions for such additional equipment as required. He later became an engineer with the City of San Francisco Public Utilities Commission. He was a reserve officer pilot in the U.S. Navy.

One day he gave the boys building a bridge across the Trinity River at Junction City a thrill by bringing his big plane down into the canyon just over the bridge. He was quite a pilot to maneuver this big plane safely down in this deep canyon where there were severe downdrafts.

There is one more bridge that should be included in this narrative. It is the Salyer bridge, a continuous truss bridge designed by Ray Huber and myself.

It is a continuous truss bridge 320 feet in length with the main span 160 feet and two side spans of 80 feet each. It is a single-lane bridge with a 12-foot roadway designed for H-15 loading. It spans the Trinity River at the small town of Salyer. The deck is 125 feet above the river at normal flow. The bridge was constructed under the supervision of Ham K. Pyles, whom you have heard of previously. His rigger foreman was Connie Wong. Wong had been taught his bridge construction when he was working under Ray Huber as a CCC enrollee. He was one member of a minority group who proved his ability in a most convincing manner. Later he was in responsible charge of a bridge crew constructing several bridges, mostly in the northwest section of the State. I think he is still employed as a bridge inspector on construction of bridges for the Forest Service. His work is invariably excellent.

It is interesting to note that many of the boys who were CCC enrollees gained valuable experience on Forest Service bridge construction. I believe that several of them later got employment on the Bay Bridge in responsible jobs.

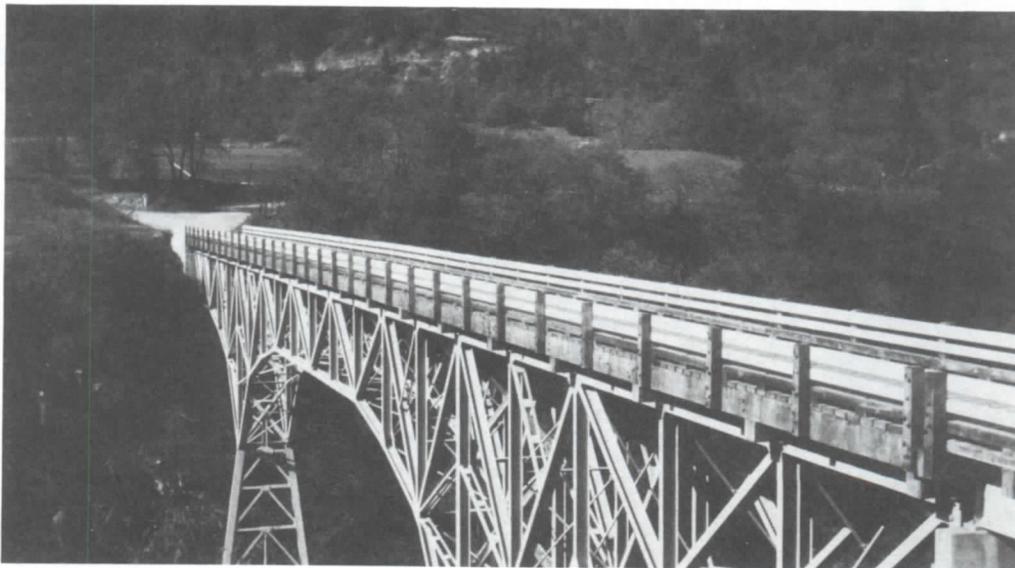
The Salyer Bridge was an unusual bridge to construct, and it was due to Ham K. Pyles' experience and ability that the construction proceeded on schedule and the resulting bridge was very satisfactory.

I almost forgot to mention that the camp superintendent of the camp furnishing labor for construction of the Gravelly Valley Bridge was Paul C. Brown. I think Paul had been with an equipment company before taking over the superintendent's job. At any rate, he was a good salesman, for he organized Equipment Services in the California Region. He established three depots: Stockton, Redding, and Arcadia. He also set up the organization of Forest shops. I think there was one on each Forest. Administrative supervision was the responsibility of the Forest; technical and mechanical supervision and assistance were the responsibility of the Depot Superintendent of the area in which the Forest shop was located. I believe that this was the first time that equipment care, maintenance, and improvements were centered under qualified mechanical engineers and mechanics. I do not remember just what year this equipment organization started, but I think it was in 1935, and the basic setup is in effect today.

Paul later became a lieutenant colonel in the construction organization of the Corps of Engineers in connection with design and construction of military landing fields. He later became a full colonel responsible for this activity throughout the Nation. Upon completion of his duties with the Army, he returned to the Forest Service at Washington, D.C., and had charge of Equipment Management activities for the Forest Service.



Junction City Bridge, Trinity River, 1936. (This is a truss and continuous beam bridge having a main span of 140 feet with two 70-foot side spans, in addition to a 60-foot steel beam approach span. The Construction Engineer was Frank W. Thunberg. The piers supporting the continuous beam were in one-pile foundation. Consequently, a heavy flood carrying much silt and debris undermined one of the piers. As a consequence, torsion occurred in the continuous beam. The beam was strong enough to support the pier hanging from the anchor bolts, and light traffic continued to use the bridge until new pier foundations were constructed.)



Salyer Bridge, Trinity River, 1936. (This is a continuous truss bridge having a main span of 160 feet. The Construction Engineer was "Ham" K. Pyles. The deck of this bridge was 125 feet above the stream under normal flow conditions. We ordinarily would have used a suspension bridge, but the approaches presented too much of a problem in providing clearance for traffic. This is the first bridge where safety nets were used to protect the construction crew from falling into the river.)

Mud Creek Project

The Mud Creek Project was authorized at the request of William R. Hearst. The purpose of the project was to prevent silt from Mud Creek entering the McCloud River drainage. Mr. Hearst wanted the river clear as it flowed by his palatial home on the river.

Mud Creek originates at the toe of a glacier on the slopes of Mt. Shasta. When the winters were light and the weather warm, the melting glacier caused greatly augmented flows in Mud Creek. Mud Creek, having a precipitous streambed, generated high velocities, which caused movement of great quantities of silt and boulders with no control. The silt continued on down to the headwaters of the McCloud River, causing heavy siltation and a murky discoloration of the stream. The purpose of the project was to divert the flow into a sand trap, then through a partially lined channel through secondary diversion channels to a large brush field.

There were two CCC camps set up to do the job. They were under the State of California Division of Forestry. However, the Forest Service supplied all the engineering designs, plans, and supervision of construction. The designs were prepared under the direct supervision of Ed Kramer, assisted by Neil Meadowcroft and Norman M. Mohr.

The plans called for a low dam across Mud Creek and a diversion structure capable of carrying flows of 40 cubic feet per second to a sand trap, which was a large concrete box structure of three compartments. The silt and heavy particles were processed through the sand trap and deposited on the slopes below the foundation. The resulting flow was fairly clear, and after being diverted into the brush field, none of this flow was returned to the McCloud River.

The project had been well designed and when put into operation performed exactly as planned. Before we completed the construction, we experienced one of the mud flows and since the diversion works had not been completed and the sand trap just started, we could not use the project to control this flow. The stream had sufficient force to roll boulders as big as a car down over our diversion dam. No damage to the structure occurred.

When the project was originally proposed by Mr. Hearst, Regional Forester Show insisted that, although the Forest Service would do the design and supervise construction, we could not assume responsibility for project maintenance since it was of no particular benefit to the National Forest.

Mr. Show had telephone conversations with Earl Lee Kelley, at that time Director of Public Works for the State of California, and was assured that the State would assume maintenance costs. There was nothing in writing confirming this agreement and since the State repeatedly denied responsibility for maintenance, I was sent up to Sacramento to talk with Messrs. Kelley and George McCoy, State Highway Engineer of the State Division of Highways.

Our conference was fairly short. Kelley admitted that he told Show that the State would maintain the project, but their idea of maintenance money was the amount that it would cost to remove the debris that was caused by the mud flow to the State Highway. McCoy had estimated that it would not

have exceeded \$600 to \$700 and would only be available at the times that the highway was damaged.

We had built a house above the diversion canal for a caretaker who would be responsible for operation of the project, his salary to be paid for by the State at such times as his services were required. I think we estimated \$4,000 to \$5,000 to prevent any siltation in or discoloration of the McCloud River from this cause.

The situation dragged along for several years. Meanwhile, without maintenance, parts of the structure became undermined, and if it were to be kept in operation, restoration would cost between \$100,000 to \$200,000, and I am sure the project was finally abandoned. It is regrettable since this was a very unusual type of construction and continued maintenance would have made the project continually operable and would have been a good demonstration of how to control and desilt stream flows.

Ponderosa Way

This project was aptly named because it was of very great magnitude extending from the south end of the State to Redding on the north and down the west side of the Sacramento Valley to Willows. Its purpose was to establish a firebreak following the timberline, with road access parallel to or on the firebreak in accessible areas.

The project was of such magnitude and involved so many high-level decisions as to locations and rights-of-way that Associate Regional Forester Jay H. Price was assigned to head up the project. He was assisted by Bill Durbin, previously Supervisor of the Lassen, and Joseph Elliot, Supervisor of the San Bernardino.

The firebreak was cleared of all brush and flammable timber. On the southern Forests, the break was also treated with chemicals to prevent or reduce to a minimum the sprouting of new cover. I believe the width of the firebreak varied from 100 to 200 feet. Construction of the firebreak, being mostly on privately owned lands, was the responsibility of the State Division of Forestry, CCC camps. However, all bridges required were designed, constructed, and supervised by the Forest Service. There were many bridges required. Most of the structures constructed were on designs we had previously used.

I do not know the status of this project at the present time. I do know that the State assumed responsibility for maintenance of all bridge structures constructed on State-acquired rights-of-way. I do not know just how this project did actually function in reduction of fires on the timbered areas.

Mono & Caliente Dams

For some time, the City of Santa Barbara had been plagued with siltation of their Gibraltar Water Supply Reservoir. A fire that had denuded a large portion of the watershed of the streams supplying water to this reservoir had caused active siltation of the reservoir. Large volumes of silt were greatly reducing the reservoir's capacity.

With the advent of the CCC program, it became possible to help the City in this siltation program by constructing two silt-retarding reservoirs: one on Mono Creek, the other on Caliente Creek.

The design for the Mono Creek Dam was conceived by Ed Kramer. Since there was no adequate rock foundation for an arch dam, it was decided to construct either a gravity dam or an Ambursen dam. The dam consists of construction of concrete buttresses at predetermined intervals and placed upon them reinforced concrete slabs. The final result was very successful, although the construction was rather difficult. This was the first Ambursen dam constructed in California.

The Caliente Dam was a concrete arch. The abutments were on good rock formation.

There were two CCC camps totaling about 400 men assigned to the construction of these two dams. I believe the name of the Engineer responsible in the field for their construction was Janes. Construction on the two dams proceeded without any particular trouble.

The year following the completion of the Mono Creek Dam, it was filled almost to capacity by flood runoff and movement of silt. The second year, it was completely filled, but by that time the watershed cover had improved so that silt production was considerably reduced. I believe it took 3 years for the Caliente reservoir to be completely filled with silt.

Construction of these two dams and the resulting retardation of silt into the Gibraltar Reservoir were of great benefit to the City of Santa Barbara and its water supply.

Truck Trail Locators

At the beginning of the CCC program for road construction, it became very apparent that there was need for engineers trained in Forest Service methods of road location and design so that there would be a uniformity throughout the State of design and construction of the road system.

To meet this need for truck trail locators, Charles L. Young, who had for many years been in charge of road location on Forest Service minor roads (truck trails), organized a school for Truck Trail Locators. I believe the headquarters was at North Fork, on the Sierra Forest. The school was well conceived and organized, and many young engineers took the course and graduated. They were immediately assigned to a Forest, with responsibility for location and design of the multitude of truck trails planned under the CCC program.

Many of the truck trail locators rapidly rose to other more responsible positions, among them John H. West, now in charge of Construction and Maintenance Branch, Region 5; Boyd Fisher, now Regional Engineer of Region 2; and George Newhall (more of him later).

Incidentally, just a side thought. Many of these men distinguished themselves as reserve officers in the Navy, as also did Wally Lund. Boyd Fisher was an officer in the Seabees and received a unit citation for construction of a water supply system for a Navy installation in the eastern war zone area. As I remember, this involved construction of a pipeline across and under a wide river. Being an old Army man, I had a selfish wish that they spent their WWII time in Army organizations. At any rate, they all distinguished themselves and did a very good job for their country.

Now more about Charlie Young. I believe that he conducted two or more Truck Trail Locators' schools until the supply of qualified locators met the need for the CCC Truck Trail construction program.

Charlie conceived the idea (I don't know what it was based on) of combining cement with native soil and forming a mixture that he called "soil cement." Personally, it should have been "soil cement concrete." At any rate, it was very successful.

The mixture of cement, native soil, and water in proper proportions yielded a tough abrasive resistant and resilient material that could be placed and hand molded to fit any drainage condition, particularly downspouts from road drainage systems. These downspouts were very successful in areas of heavy precipitation, particularly in southern California.

Many miles of road were saved from destruction under torrential rain conditions, which quite often occurred in the south. In addition, this soil cement concrete was used in construction of many small food control low dams under the Flood Control Project (more about this later).

Not satisfied with all these accomplishments, Charlie was assigned a task of preparing the Drainage Handbook. This was most useful and quite necessary to design of culverts and other drainage structures. I believe it is still the drainage textbook for all truck trail design engineers in the California Region and other Regions.

During the CCC program, many buildings for Forest Supervisors' Offices, Ranger Station developments, warehouses, water supply systems, and communication systems were constructed on all the Forests. Completion of the improvements gave the Forest Service an up-to-date physical plant and rendered the job of National Forest Administration much more efficient and easier.

During the same period, the California Forest and Range Experiment Station constructed facilities and utilities that would probably never have been accomplished without the CCC program. One thing the Forest Service did find after the program was completed, there were many problems of finding sufficient maintenance funds to keep the plant in good shape and to prevent rapid deterioration because of reduced maintenance funds from regular sources.

Desk Chair Period

General

This narrative covers the period from about the end of the CCC days to the time of my retirement, which was effective September 1961. It was to begin with quite a job of change from being an old "construction stiff" to a job where diplomacy and protocol were the principal ingredients of the job. It was a considerable letdown in the beginning not to be able to plan some construction project and then see it accomplished. When I changed to the new job, Ray Huber took over as Bridge Engineer, and the good things he accomplished spoke for themselves in the physical plant of the Forest Service and development of new men to carry on Forest Service activities.

It was quite difficult for me to sit at a desk and talk about things when Ray would show me a new design or plans of a difficult construction job. It was all I could do to keep from putting on my hat and going out with Ray to the scene of action. I might explain this feeling a little better by telling you of my experience when I quit smoking cigars. I used to smoke an average of seven cigars a day; then all of a sudden, I decided to quit. From then on, I smoked cigars at rare intervals. For the first 2 or 3 weeks, if a man passed me on a street smoking a good aromatic cigar, I was always tempted to turn around and follow him and get the benefit of the aromatic smoke.

It was during this period that "Honest John" Beebe, at that time Regional Engineer, obtained my promotion to Assistant Regional Engineer. This was a most gratifying promotion for an engineer who had come up through the ranks without any formal education and, thereafter, I tried to conduct myself as an Assistant to the Regional Engineer would.

I named him "Honest John," and the appellation stuck with him because he was just that. There was no subterfuge about him. He considered every problem and gave an honest and straightforward reply. As to his feelings about the matter, without reservation, this trait was recognized by any and all who had dealings with him. He did not depend on fancy clothes to enhance his position as Regional Engineer. He was the friend of many governors who respected his manner of replying to inquiries with the full knowledge, as his answers were made to the best of his ability under the circumstances involved.

I labeled this the "Desk Chair Period," but it was not truly a desk chair period in its entirety. For instance, there were many field trips, many trips on which I could ride into the backcountry on trails and many trips to meetings, but it was entirely a different thing in the beginning from going out and watching a construction project grow as planned.

Some of the field trips were in connection with the review of functional engineering activities on certain Forests and on one occasion an integrated review of all Forest activities. This review was with George James, a very capable and knowledgeable man, as the senior member of our team. I was fortunate to be a member of the team.

You have probably noticed that I have avoided the word "inspection." The functional reviews were generally listed as functional inspections, and the integrating reviews were also inspections. George and I prepared a foreword

to our report on the Mendocino in which we deplored the use of the word "inspections." To designate the job to be done, we pointed out that we were not there to inspect things, but to review what had been done and what was being done, commenting on both good and bad practices that we found. We both felt that we were out there to help the Forest and not to call them to task for minor deviations from instructions and directives. There was never any comment at the Regional Forester's level on our proposal to designate these actions as reviews.

For my own part, when I visited a Forest, I felt I was there to help them gain a satisfactory performance in all Forest Service activities for which they were responsible. I made it a point never to include anything in my written report after the field review until I had discussed it with the Forest Supervisor. He was never confronted when Regional reviews were made of their report with an item that he had not been previously advised of.

Perhaps some of my aversions to the word "inspection" stem from an experience that I had when I was a buck private in the cavalry. Shortly before noon one day, we were told that the general would be in the troop area about 2 o'clock, which gave us little time to get things in order. For about 2 weeks previous to this inspection, I had been functioning as troop saddler in the absence of the regular saddler. I became so engrossed in the work of repairing saddles, bridles, and other horse equipment that things I would normally do, like keeping my rifle in the best of condition, were sidetracked, and as a result, just prior to the captain's inspection before the general arrived, I looked down the barrel of my rifle and it was certainly not clean. I had no time to find a rod and a piece of waste to run down through the barrel, so when the captain went along the line, I presented my rifle for inspection. He commented it was a very dirty rifle and I would hear from him later. Then shortly, the general came along and it would be my luck for him to inspect my rifle. I will never forget the look of consternation on the captain's face when the general said, "Captain, now, here is a rifle in good condition. Take a look at it." The captain said, "Yes Sir." What else could he say? So I did not get any call because the superior officer differed from the commanding officer on what constituted a good rifle. By the same token, the teams on the Forest on the so-called "inspection" could cause as much confusion as an umpire in a baseball game who would call what was obviously a strike, a ball.

The field trips incident to these reviews were very enjoyable. Many of them involved 3- to 4-day pack trips, which I truly enjoyed, just by being on a horse again. The records of what we saw and commented on are in the Regional Forester's file. Sufficient to say, conditions were, in general, a lot better than would be expected under certain complicating conditions.

I do not remember the exact date, but I think it was 1948 or 1949. There were many Federal and State agencies and others interested in the potential development of the upper drainage of the Middle Fork of the Eel River. With Regional Forester Pat Thompson's approval, I organized a 4-day pack trip into this backcountry. Each day's trip averaged about 22 miles. We would start fairly early in the morning and arrive at our campsite in mid-afternoon, in time for anyone who wanted to do a bit of fishing in good fishing waters. There were 24 members of various agencies on the trip, and, in addition, the packers. I cannot remember all of those who

participated, but for the Corps of Engineers, they were represented by the Division Engineer, Colonel Johns; his principal civilian assistant, Owen G. Stanley, who you will hear more about later; and Otto Von Seggern of the San Francisco District Office. The State Department of Water Resources was represented by a man named Holmes, who was engineer of dams for the State. The Soil Conservation Service was represented by a geologist, as was the U.S. Bureau of Reclamation. The California State Chamber of Commerce was represented by Emmett Stewart, chairman of the National Resources Committee, and the manager of the Redwood Empire Region of the Chamber. The Sierra Club, who were interested because they were seeking the formation of a primitive area in the headwaters of the stream, were represented. The Forest Service was represented by the host, Pat Thompson, David Ilch of the Flood Control Section of the California Forest and Range Experiment Station at Berkeley, Bill Fischer, at that time Forest Supervisor of the Six Rivers National Forest, Fred Cronemiller, who cooked many delicious meals for the group, and me.

Because of the rugged terrain to be traversed and the difficulty of organizing a large enough pack train to carry all supplies, all of the hay, grain, and other equipment necessary to the functioning of the unit were dropped by Forest Service planes at our predesignated camp sites. All articles hit on target, and there was little damage to any packages dropped.

We left from the Covelo Ranger Station and made our first overnight stop about 26 miles from where we started, about 3:30 that afternoon. This gave the participants a chance to rest up or go fishing before supper. I remember that Ilch prepared a tremendous tossed salad and Cronemiller, with assistance from others, prepared the evening meal consisting principally of steaks. The fish that the members had caught served as excellent breakfast food together with some other incidentals.

On the first night, many of the participants on the trip who had never met the others treated each other as "Mr." or "Colonel" or the man's known title. The informality of the group was demonstrated the following evening when the salutations were addressed to Jim, George, Bill, or whatever the man's name was.

The purpose of the trip was completely accomplished during the day's ride. Various points that were under discussion as possible dam sites or diversion sites were viewed. The Sierra Club representative had a good chance to examine the possible primitive area. Some of the beneficial results of this trip showed up in subsequent months.

The trip proved to the satisfaction of the Sierra Club representative that the area as had been proposed as a primitive area could not qualify in that category.

A direct result of benefit to the Forest Service was the recognition by the Division Engineer, Colonel Johns (shortly thereafter Brigadier General), of the many problems of Forest Service administration. We had pending, at the time of the trip, a recommendation to the Corps of Engineers for construction or relocation of various roads and Forest Service improvements to be inundated by the construction of the Pine Flat reservoir. Shortly after his return to San Francisco, Owen G. Stanley called to say that the Corps of

Engineers was willing to accept our recommendations. We had anticipated considerable discussions prior to the Corps' acceptance of our proposals. This was truly a "show me" trip in which each agency and person participating benefited. It was in no sense a junket.

When Charles A. Connaughton became Regional Forester, George James and I proposed a similar trip to other drainages, but he could not see where it would be of great benefit to the participants.

**National Resources
Planning Board, Water
Resources Committee**

Before the organization of the National Resources Planning Board, Water Resources Committee, the State Planning Board got into the picture. This is where I really got started on desk chair work. The State, for Drainage Basin programming purposes, was divided into the North Coastal area embracing streams flowing into the ocean from San Luis Obispo north to include the entire Klamath and Smith River areas.

The second Basin was the Sacramento-San Joaquin Basin, embracing all streams from Sacramento River Drainage on the north to the Tehachapi Mountains on the south.

The third Basin covered the entire southern California area from the Tehachapi Mountains on the north to the Mexican border.

The last Basin was the Great Basin, which included all streams rising on the east slopes of the Sierra Nevada Range and extending east, embracing streams on the west slopes of the Rocky Mountains.

Of course, the California Region of the Forest Service was primarily interested in streams draining the east slopes of the Sierra Nevada Mountains. The State Planning Board had requested Regional Forester Show to prepare reports covering Forest Service activities and problems in the various basin areas, with primary concern to deficiencies in plans and programs to meet National Forest responsibility for protection and management in these basins.

It was my job to find out what was needed and prepare the reports, ghost-writing for Show. In this job, I learned to use many of his phrases and descriptions, particularly in the southern California area.

It was also my job to take these reports as written, discuss them with a Mr. Bates, who was in charge of State Planning Board Act. He was located in a small office in the old Appraisers Building, which was a brick building with walls about 3 feet thick and constructed, I believe, shortly after Civil War days. This building was torn down to make room for the present Appraisers Building at 630 Sansome street. I do not believe that any fire or earthquake could have razed the old building.

Shortly after completing the reports mentioned above, the Federal National Resources Planning Board was organized, committees established, and plans developed for participation of all interested Federal agencies in each basin area. We were, of course, primarily interested in the same programs and problems enumerated in our reports to the State Planning Board. The reports were reviewed, supplemented, and broadened to meet the scope of coverage contemplated when the National Resources Planning Board was

organized. A Basin consultant was appointed for each of the Basin areas, and he acted as chairman for the many meetings required for each Basin.

These meetings were attended by representatives of all Federal agencies having any interest or responsibilities in developing plans and programs for water development. They included, besides the Forest Service, the Soil Conservation Service, U.S. Bureau of Reclamation, Federal Power Commission, Corps of Engineers, and the Hydrology Branch of the Weather Bureau.

Meetings were held in a principal city in the Basin area under discussion. At these meetings, each agency would submit descriptions of ongoing projects in the water use or development field and projects necessary to meet the forecast of requirements in the future.

I attended all of these meetings, representing the Regional Forester or the Regional Engineer when these two officials were not available. The meetings were very interesting and beneficial, but they did not result in a coordinated plan to meet the water requirement of the area.

One of the principal benefits, in my belief, was the fact that personnel of the various agencies active in the work became acquainted also. Where there were conflicts between agencies concerning projects, they were brought to light, but were not resolved.

The listings of proposed projects of each agency were currently revised at subsequent meetings, and although this was very enlightening, it did not result in a coordinated program.

An attempt was made to obtain a coordinated program on the Santa Ynez River drainage. The Coordinator was Walter L. Huber, elder brother of Ray Huber and a recognized authority on water resources problems.

At our meetings to discuss this coordinated program, each agency was requested to set forth in specific detail what their proposals were for the drainage. Attempts were made to set up firm dates on which each agency would submit its report. In spite of the ability of Walter Huber to get people working together, I do not remember that we arrived at a fully coordinated program before the activities of the National Resources Planning Board were discontinued. I do know that Walter deservedly received high commendation from Washington, which I believe included a personal commendation from President Roosevelt. There is one thing that was accomplished and that was recognizing and bringing to national attention the many problems involved in water resources use and development in the Nation. Comprehensive reports were compiled by drainage basin for the Nation and were included in a general publication of the subject.

Flood Control Act of 1936

By the Flood Control Act of 1936, the Corps of Engineers was directed to make surveys and plans for control of floods; the Department of Agriculture was directed to make surveys, prepare plans, and recommend programs of measures for runoff water flow retardation and soil erosion prevention in aid of flood control on the same streams that the Corps of Engineers reported on. The Act specifically stated that the cost of all measures for both the Corps of Engineers and the Department of Agriculture programs should not

exceed benefits to whomever they may accrue from installation of programs. A primary listing of streams to be covered by these surveys was prepared. It was added to from time to time at the request of a Congressman from the area a flood control survey was deemed necessary.

I believe that the Department of Agriculture got into this picture primarily at the instigation of E.N. Munns, in charge of watershed influences research in the Washington Office. He sure got his foot in the door and later kicked it wide open, getting national recognition of the need to do something to ameliorate conditions in watershed areas and on agricultural lands that were contributing to floods downstream.

For the first time, the Corps of Engineers and the Department of Agriculture participated jointly in public hearings. At these public hearings, local residents and organizations interested in the flood control problem were invited to present their problems. Both the Corps of Engineers and Department of Agriculture representatives asked questions concerning local proposals and local suggestions.

There was generally harmony between the two Federal agencies, but I do recall one meeting down at Los Angeles where the District Engineer seemed to have the feeling that nothing the Department of Agriculture could do would have any effect in reducing flood flows, and that he would have to design his control structures on the basis of a denuded watershed. I remember this District Engineer well. He was Major Theodore Wyman who managed to cut off much discussion of watershed problems.

I recall one time, Regional Forester Show attended a hearing where Major Wyman presided. Show himself was a knowledgeable man and he could talk, but he was not inclined to raise his voice in authority as the Major was. I remember Show describing him later as the only man who could "strut sitting down." Wyman later became Brigadier General in charge of construction of the Alcan Highway. The Major had two excellent Civil Engineer assistants: George D. Bebout and E.C. La Rue. Incidentally, La Rue participated in the exploratory trip down the Colorado River at the same time as L.B. Lint.

After the Flood Control Act of 1936 was passed and became a law, the Department of Agriculture had set up committees across the Nation composed of representatives of the Forest Service, Soil Conservation Service, and the Bureau of Agricultural Economics. The committees were chaired by either the Forest Service or the Soil Conservation Service member. The selection was based upon whether the watershed was primarily forested land or agricultural land.

In the area embraced by California and western Nevada, two committees were set up. Committee No. 18, chaired by E.I. Kotok, Director of the California Forest and Range Experiment Station, and Harry E. Reddick, Director of the SCS, as chairman of Committee No. 20.

These two gentlemen got together and decided they would be cochairmen of both committees. They felt that it would be of mutual benefit to both services to carry on activities under the Flood Control Act jointly.

I became Executive Secretary for both committees. My responsibilities were manifold and too numerous to mention in detail. Sufficient to say, in my position, I had to exercise considerable diplomacy since I represented both services in dealings with the Corps of Engineers, BAE, State, private agencies, and others.

The following is the organization of each of the two committees:

Committee No. 18

- (1) E.I. Kotok, Forest Service Cochairman.
- (2) Charles J. Kraeble, California Forest and Range Experiment Station, in charge of the Division of Forest Influences as Project Leader.
- (3) David Ilch, assistant to Kraeble in Forest Influences, Party Chief.
- (4) Many assistants too numerous to name.

Committee No. 20

- (1) Harry Reddick, Regional Director of Soil Conservation Service, Cochairman.
- (2) John Johnson, SCS Engineer, Project Chief.
- (3) Howard Gabbert, Party Chief.

Both Committees—John H. Lawrence, Forest Service, Executive Secretary.

In addition, I was responsible for a unit called Central Service, which prepared in final form maps and charts and assembled all reports, including maps, charts, data and text for the survey reported upon. The head of this Central Service unit was C.A. Davidson, Forest Service Engineer, assisted by Herman J. Fittenger. A.W. Lund was responsible for and in charge of the drafting unit, which prepared in final form all maps, charts, and diagrams required. The Photo Reproduction Unit took care of all the reproduction of maps and other data. The clerks in the Central Service unit, in addition to my secretary, typed and assembled the mimeographed copies of the text.

I cannot overemphasize the excellent work done by this Central Service unit in handling three member agencies of the committees and putting the report in final form.

Now as to procedures: First of all, a joint public hearing was held by the Corps of Engineers and the Department of Agriculture at locations selected by the Corps within the drainage of the stream at that time under consideration. This joint hearing was held for the purpose of obtaining facts on flood and on watershed and agricultural land conditions and local recommendations for projects to alleviate flood flows. At first, it was difficult to get any amount of testimony from the local people and organizations as to watershed and agricultural land problems. Later, as the pattern of these hearings took form, we were able to obtain active participation in connection with the Department of Agriculture programs and problems.

Testimony at these hearings was taken by stenotype services contracted by the Corps of Engineers. Copies of the transcripts of the hearings were made available to all interested agencies. I have not previously mentioned the role of the Bureau of Agricultural Economics. Their job was to analyze the cost-benefit relationship for all proposed Department of Agriculture programs. In order to secure approval of any program, the cost of the program could not exceed the benefits that the program would bring to flood control.

I also failed to mention that the committee member for the BAE was Edwin E. Wilson, assisted by Economist Woodruff, as project leader, and a Dr. King (he always wanted to be called doctor) as Party Chief.

I believe that when the committees were originally organized, the Bureau of Agricultural Engineering for Irrigation was a member bureau. Participation was by Engineer Mitchelson.

The first step was the selection of one of the streams authorized by the act and on which public hearings had been held. The first stream for preparation of a preliminary examination report was the Kings River. This report covered the area problems and a proposal for Department of Agriculture programs, which were required to meet two objectives of the act as far as the USDA was concerned. No economic justification was prepared for the programs considered necessary. It was recommended on the basis of judgment by the committee that the program could be economically justified. It was in preparation of this first preliminary examination report, and the field work by the crews of the Forest Service and SCS, that certain approaches by each agency were to some degree divergent to the basic approach to solutions of the problems by the two committees.

We had many meetings at which acceptance by each agency of the other's approach and program recommendations was worked out. A reluctance by each agency to accept the other's ideological planning still persisted. In a later Preliminary Examination Survey, these differences were minimized, and when final authority for preparation of a survey report was given, the two agencies were working much more harmoniously than at the beginning.

The BAE became a thorn in the side of each agency. Their insistence on a thorough economic analysis was finally admitted as fully justified.

I will diverge from my narrative statement to give you a little idea of how the Forest Service and SCS entered into this program. I remembered we had a full-scale conference in Director Kotok's office, in Giannini Hall on the UC campus, which was participated in by the three Department of Agriculture agencies and representatives of the Corps of Engineers' District Office at Sacramento. If I remember correctly, Lt. Col. L.B. Chambers, then District Engineer of the Sacramento office, attended. Ed Kotok served as chairman and in his opening remarks stated, "Gentlemen, we come to you with clean hands." Ed gesticulated with his hands as witness to his statement. Unfortunately, he had failed to visit his manicurist that morning and the evidence presented left a wide credibility gap to his statement.

The reason I mentioned this is that at a subsequent meeting, I overheard Harry Reddick repeating this episode to people outside of both the Services to the disparagement of Ed Kotok. Harry did not get over an apparent

jealousy of Ed Kotok until much later in the program. This made my job as Executive Secretary a little more difficult since I had to tie both agencies together in a harmonious rendition of our joint activity. I must have succeeded since I had the confidence of the chairmen of both committees. And the letters that I prepared received the joint endorsement of both chairmen.

After a survey report was approved, following submission of a Preliminary Examination Report recommending that a survey report be prepared, field parties were organized. They were headed up by David Ilch for the Forest Service and Howard Gabbert for the SCS.

Before we had completed the survey report for the Kings River drainage following the floods of 1937-38, we were directed to prepare a survey report in the Los Angeles River watershed covering the Arroyo Seco drainage by the Forest Service and the San Fernando Valley Agricultural Lands by the SCS. The result was a combination report by the two agencies recommending programs in these two areas to the Forest Service in the Arroyo Seco and SCS in the San Fernando Valley area. The result was a voluminous report about 4 inches thick, which requested a total of a little over \$6 million for the two areas. The bulk of the program as recommended and approved was in the Arroyo Seco drainage. It involved four specific techniques:

- (1) Cover Improvement—Which was for the purpose of intensifying the natural cover to reduce soil losses.
- (2) Road Improvement—Which involved the stabilization of cut and fill slopes and improvement and installation of methods of controlling runoff from road surfaces.
- (3) Fire Control Improvement—Which involved the establishment of physical improvements to detect and facilitate attack on fires. It included construction of certain new roads, buildings to house suppression crew personnel, and attendant facilities required, including storage tanks for retention of spring runoff as an additional supply of water for fire control purposes. Shortly after approval and allocation of funds, the program was started. (I will tell you about this later.)
- (4) Channel Improvement Program—This program was designed to stabilize the stream channels and reduce movement of channel side slopes into the stream under floodflows. It consisted of a program of construction of small retarding dams for three purposes: one to retard movement of silt under floodflows; another to prevent downgrading of stream channels; and to prevent sloughing of side slopes with consequent bulking of streamflows. The program, as originally conceived, consisted of construction of numerous low dams and stabilizing of stream channel banks, which were being eroded, by means of planting. This part of the program showed the biggest value in the cost-benefit analysis. But when channel surveys were made, it became apparent that the program of multiple construction of small dams was considerably more expensive than originally estimated. Consequently, for this first action program, effort was concentrated on construction of dams that would result in the greatest accomplishment of the purposes of the program.

One point that I have overlooked was that since the Forest Service was occupying office space in the UC Land Grant College Buildings, Ed Kotok had agreed with the University's College of Agriculture that he would request a review of Department of Agriculture reports by the College prior to submitting a report to Washington for approval.

In my recollection, Dean Hutchison was in charge of the College of Agriculture at Berkeley and he was assisted by Frank Adams of the Branch of Irrigation Agriculture, and it was he who actually reviewed the reports. Frank Adams was a very able man, he knew his job well, and he could not be swayed by hysterical appeals by either of the two USDA agencies. It is my feeling that he had a large part in obtaining a good soil control program for the Department in aid of the reduction of floodflows.

One incident might be worth repeating in connection with the economic evaluation of our program: the BAE called for direct benefits and ancillary benefits. I think there was only one member of our group who knew what "ancillary" meant. Naturally, it was Charlie Kraebel, a genius in the use of polysyllabic words. I might tell you a story that Charlie told me himself. He was addressing a woman's club in southern California in the use of vegetation in stabilizing road slopes. One of the vegetative measures he recommended was the planting of "mesembryanthemum." He had noticed one woman in the audience who had looked at him quizzically, and thinking that she was uncertain what the word meant, he nodded to her and said, "Iceplant to you, Madam." Her reply to him was, "Nuts to you, Mister." I told Charlie I was going to include that story in my narrative, so here it is.

After all, if you reason it out or look in the dictionary, you will find that "ancillary" means handmaiden service—that is, benefits, secondary in nature, which would be attendant by accomplishing the direct benefits. If I have made this sufficiently confusing, please look it up yourself.

In case that the foregoing narrative about Charlie might give you the wrong impression, I will tell you something about that gentleman. First of all, he was a real authority on the use of vegetation in controlling movement of soils under heavy rainfall conditions. I think he was instrumental in the use of wild tobacco in stabilizing highway cut and fill slopes. I know that before the beginning of the flood control project, much of this had been done on two highways in the Angeles National Forest with very successful results. Further than that, his personality and affability were keys to the final solution of the conflicts between the FS and SCS representatives and field crews. He was well liked and recognized by all as an authority on silvicultural practices in aid of flood control.

In witness to his ability in this field, on his retirement from the FS, he was sent to Japan as a member of General MacArthur's staff in the field of rehabilitation of watersheds in Japan. His work there was recognized and applauded, although I understand he never did get to meet General MacArthur himself.

I have heard that Charlie has received the highest honor that a man in the field of forestry could ever get. He is a "Fellow" in the Society of American Foresters.

Before going on to the action program, I will tell you of some other people who contributed considerably to the final amicable work relationship between the FS and SCS. Incidentally, the SCS was originally set up as the Soil Erosion Service. It was soon recognized such a nomenclature was not in keeping with the principle on which the Service was established. It is conceivable that under the original designation, people could conceivably get the idea that the Service was organized to increase erosion. It was not long until the designation was changed to SCS, which properly states the basic principles of prevention of erosion and soil movement by education and projects aimed at reduction of soil movement.

The real beginning of establishment of real working arrangements between the FS and SCS started with the field crew. For the FS, Herman J. Fittenger, who was a member of the Central Service staff, performed a yeoman job in getting members of the field crews to work together amicably. I remember many instances when some of us, both from the FS and SCS, met at nighttime in Fittenger's quarters at the Elks Club in Berkeley, where, under convivial conditions, we were able to discuss points of disagreement.

Impassionately, for the SCS, Howard Gabbert and Henry Fox were principal contributors. We were able to get down to brass tacks and discuss points of variance without acrimony. Part of this might be due to the fact that Gabbert and Fittenger had both been members of bands or orchestras in Santa Barbara County. Fittenger, Henry Fox, and Percy Rowe of the Experiment Station decided to get together and see if they could work out a formula for evaluating quantitatively the reduction in soil movement under varying conditions and programs in the report for the Russian River drainage. Their approach to this problem was rational and nonhysterical and appeared to meet the requirements for flood program evaluation. Too much cannot be said in commendation of Clifford Davidson, Chief of the Central Service unit, in his conduct of the work of this unit in presenting in final form maps, charts, and diagrams supporting Department of Agriculture reports and program proposals. Woodruff, an economist of the BAE, also deserves a special commendation for his work in humanizing the cold-blooded approach by the economists in program justification.

Before I proceed with further discussion of the Action Program, let me make this statement. Shortly after the Action Program was approved and funds appropriated and allotted for installation purposes, I was asked to speak to a meeting of the Northern California section of the Society of American Foresters in Berkeley to tell them what this program meant. I described in detail the program, and most of those present expressed considerable concern over the fact that the program as approved did not contain many uses of silvicultural practices, such as tree planting to accomplish the flood control job. I tried to explain to the members present that all of the items on the program had to be economically justified to be approved and that it was very difficult to demonstrate and economically evaluate just how effective planting programs were in reducing soil movement and reduction of flood-flows. To this date, they think that we could have done better, but with this requirement for economic justification, we had no adequate basis for recommendation of other silvicultural programs to apply.

Forest Service Action Program Under Flood Control

After approval of the program, most of the funds allotted to the Region to accomplish the program were transferred to the Angeles National Forest, which was at that time under the supervision of William V. Mendenhall. He had been an active participant in all of our program discussions and was well aware of the methodology required to accomplish the program within the financial and other restrictions and limitations prescribed by the Survey Report. Because most of the phases of the program were of an engineering nature, Engineer E.R. (Ray) Huber was transferred to the Angeles to head up the work, and he continued there until an enlarged program covering other tributaries of the Los Angeles River was approved and funds provided for its accomplishment. Ray Huber's services being required elsewhere on other Forest Service projects of considerable magnitude, he was replaced by M.B. Arthur, who had been in the Washington Office. Arthur was a man of considerable ability and knowledge on construction of low dams. As a matter of fact, he was the principal author of a Department of Agriculture publication entitled, "Low Dams," which incidentally had and is still in widespread acceptance by engineers nationwide.

As the program became well established, it became the responsibility of the Forest Supervisor, the Forest Engineer, and other members of his staff furnished by the Regional Office to carry on the program.

"Mal" Arthur was transferred to Region 1 as Regional Engineer.

Now to go back to the original Arroyo Seco program. First, the cover improvement program as previously stated: the purpose of this phase of the Flood Program was to vegetate areas that were inadequately stocked with new vegetation. Under the history of major burns in parts of the Arroyo Seco watershed and with the financial limitation for this phase of the project, it was a tough job to do. Fortunately, the Forest Service was able to get the service of "Gus" Jurhens, a man who had much experience in the use of vegetation to prevent erosion. As a matter of fact, he had been in charge of and was responsible for the successful stabilizing of highway slopes in San Diego County, principally on the highway to Palomar Mountain Observatory. For the Arroyo Seco program, he established a nursery and propagated many different types of vegetation, using sample plots to determine the efficacy of various types of vegetation. It was a difficult program necessitating installations on a cut and dry basis. What I saw under the final installation appealed to me as successful, but with fund limitations, the applications of various treatments were not all that they should have been. Gus Jurhens always assisted in preparing specifications for planting on cut and fill slopes of old roads and new road construction under the road improvement program.

Road Improvement

The Road Improvement Program was one of the four phases of the program that showed a high degree of economic justification, and rightly so; erosion from mountain roads had long been a prime contributor to movement and erosion of soils into the stream channel.

Vern Eaton was selected to handle this phase of the program. It was his responsibility to resurvey all roads that, through inadequate design, were contributing to the bulking of floodflows. In his resurvey of these problem areas, he made definite plans and set up programs for installation of

adequate drainage facilities and also plans for vegetative planting to stabilize the cut and fill slopes that were eroding. In this latter phase, he was greatly assisted by Gus Jurhens who was in charge of the Cover Improvement Program.

Under the Fire Control Program, many miles of new roads were constructed. Vern Eaton's job was to see that adequate provisions were made for stabilization of slopes and installation of drainage structures adequate to take care of anticipated heavy runoff from road surfaces. The program was quite successful. The techniques developed were used on many other roads constructed for fire control purposes in other drainages.

Fire Control Improvements

A comprehensive program had been planned in the survey report to provide facilities and housing, anticipated additional detection, and suppression forces required to meet the objective of a maximum of two-tenths of 1 percent of the watershed burned area per year. Whether or not the Fire Control Improvement Program actually met this objective, I do not know. I do know this: that when a fire starts in the brush-covered mountains under adverse climatic conditions, it could readily change the figure for annual burned acreage and upset the average annual burn in terms of percentage of watershed areas. I believe that later, in spite of all the precautions, planning, programming, and installation of improvements called for by this program, such a fire did occur in the Arroyo Seco watershed.

The authorized program provision had been made to provide additional funds annually for increased personnel required and for maintenance of physical structures. The personnel of the Angeles National Forest, assisted by Ray Huber's Flood Control staff, were responsible for installation of additional physical plant requirements. George Reynolds, Forest Engineer of the Angeles, was responsible for this phase of the program.

Flood Control Improvements

Donald MacBean, a man with considerable previous engineering experience on design and construction of hydraulic structures, was selected to head up this program. Due to the fact that his type of stream control was new in Forest Service programs, Ray Huber spent a large portion of his time on this phase of the project.

A resurvey was made after review of the studies made by the Flood Control Survey organization. It soon became apparent that the objective of the Flood Control report was to stabilize the stream and its tributaries, so that there would be no degradation of stream channels, and so that the stream system would be maintained at a stream gradient or slope. This would prevent accumulation of soil and debris movement to the Devil's Canyon Reservoir. It was first necessary to provide a structure or structures that could immediately function to reduce these damaging flows to the point of justification for the Flood Control Program indicated by the report.

Accordingly, a structure was designed and constructed below the mouth of Brown's Canyon. It consisted of a concrete arch dam approximately 40 feet in height between the streambed and spillway. The structure, when completed, performed very satisfactorily. With the initial construction in the expanded program, Coon Canyon was selected for experimentation on the

possibility of controlling flood debris movement by a series of low dams seldom reaching more than 6 feet in height from streambed to spillway. With adequate funds to do this job, the original proposal for stabilizing through a series of low dams at a predetermined interval was designed and installed. Many of these dams were constructed of the so-called "soil cement construction," some were of rock construction guniting, and some of them of concrete piped to the dam site.

The first test of these installations proved that the technique was successful, and not having heard any subsequent report to the contrary, I feel certain that it substantiated the claims of proponents for this type of stream stabilization. I believe that the Angeles National Forest still receives funds annually for continuation of this program.

Cooperation With Other Agencies

General

If two agencies are interested in a certain subject, and one agency makes every effort to accomplish a certain program of interest to both agencies while the second agency does nothing toward obtaining a joint solution to the problem involved, that is not cooperation. Cooperation means meetings and discussions to iron out points of difference and to come up with a solution satisfactory to both, and also to all agencies involved in the particular problem at issue.

Real cooperation between Federal, State, and local agencies began in the National Resources Planning Board meetings. At first, it was sporadic; but later, it developed rapidly and at the time of my retirement, cooperation was a reality.

One of the major items, in my opinion, that affected the degree of cooperative participation was the method of approach of the agency desiring acceptance of its proposal on certain issues, particularly those involving contributions of money.

Another important point in obtaining cooperation is to let the people you want to cooperate with you know your problem and how their participation in a cooperative deal would be of assistance to you and also to them. As a discussion of this subject, I will cite instances where this has worked to great advantage in obtaining solutions to mutual problems.

Federal Agencies

Army Corps of Engineers

The Army Corps of Engineers is divided throughout the U.S. into several divisions. In California, it is the South Pacific Division, which embraces California, Nevada, Arizona, Utah, and parts of Wyoming, Colorado, and New Mexico. It is composed of three districts: San Francisco District, embracing the coastal areas from San Luis Obispo north into Oregon to include the drainages of the Klamath and Smith Rivers; Sacramento District, embracing all areas in the Sacramento and San Joaquin Valleys and extending eastward into northern Nevada, western Utah, and the southern tip of Idaho; and Los Angeles District, embracing all of southern California south

of the Tehachapi Mountain range, and extending eastward to include Arizona, part of western New Mexico, the southern part of Nevada, the eastern part of Utah, the southern part of Wyoming, and the area of Colorado west of the Continental Divide.

The Corps of Engineers transacts all real estate deals required and requested by the Sixth Army. It also designs and constructs all flood control improvements within its boundaries and designs and constructs military installations and facilities required and requested by the Sixth Army. The Corps of Engineers does not report to, and is not under the jurisdiction of, the Commanding General of the Sixth Army. It reports directly to the Chief of Engineers, Washington, D.C. You can see that the Corps of Engineers has widespread responsibility for both civilian and military construction.

Our official relationships with the Corps of Engineers, with very few exceptions, were very harmonious and of benefit to the accomplishment of the work assigned for the public in general. Most of our dealings were with the civilian personnel because they stayed in the area for a much longer period of time than the officers who are subject to transfer to other locations after 2 or 3 years.

I will name a few of the civilian personnel with whom we had many contacts and official dealings. The first one was Owen G. Stanley, Chief of the Civilian Personnel of the South Pacific Division. The original contact was made through J.C. Beebe because of his previous association with Stanley—that is, association prior to Beebe's appointment as Regional Engineer and Stanley's transfer as Chief Civilian Engineer from Sacramento to Division headquarters at San Francisco. His assistant was John C. Marcroft, who was always a good contact and a good cooperater. We also had cooperation and contacts with the hydrology section of the Corps in San Francisco.

The district offices of the Corps are autonomous in that any problems of cooperation with the Corps are always referred to the District Office of the area in which the problem exists. We have had particularly good cooperation from the Sacramento District, through the Chief Civilian Engineer, Frank Kochis. This was very true in matters pertaining to an agreement between the Corps and Forest Service for location and replacement of Forest Service improvements and facilities necessitated by construction of the Pine Flat and Isabella Dams, and subsequent inundation by the reservoirs of areas behind these dams.

The trip that I previously mentioned to the Eel River Drainage gave the Division Engineer and Stanley a good idea of Forest Service requirements. Shortly after this trip, the Corps speeded up their action on our recommendations for both of these projects, and we received what we requested in our proposed agreements.

The Corps is not required to replace any facilities to a greater standard than that existing at the time field investigations were made. However, when we indicated to them that their proposed relocation of the road up the Kings River Canyon did not provide adequate access to timber areas that were then being logged, we suggested a road that would satisfy the requirements of transportation of timber. The Corps made a complete resurvey and

submitted the designs to us for review. We found that their new design was entirely adequate, and the Corps proceeded with contracts for action.

There were many arrangements and agreements with the San Francisco and Los Angeles Districts—items too numerous to mention. I will mention that the Real Estate Division of the Corps, under a Mr. Cupples, worked closely with us on many problems arising from Army use of National Forest lands, such as location of access roads to Army radar stations and other items. The Real Estate Division of the Corps reports directly to the Division Engineer and not through the construction and design units. The Real Estate Division handles all transactions pertaining to land-use acquisition or exchange. It became apparent that, through our discussions and negotiations with the Corps, our efforts to obtain what we needed were greatly facilitated. Drafts of our reports and proposed agreements were made available to them prior to meetings to discuss our proposals.

Another branch of the Corps of Engineers was responsible for planning design and installation design of military landing fields and attendant facilities, including transmission stations. We had very good working relationships with them from the beginning and toward the end of the program. Paul C. Brown, previously mentioned, was appointed a full colonel and headed up the program in Washington.

Incidentally, at the beginning of World War II, there was a tie-up of selling of structural timbers except to agencies for military purposes. We had a phone call from Arvil Anderson, who told us of his needs for structural timbers and his inability to obtain them locally, so I contacted O.G. Stanley, whom I referred to previously. He checked and found that the Corps had a surplus of structural timbers at the Oakland Army Base and made arrangements for us to obtain items that we required at no cost to the Forest Service except transportation charges. Anderson made a list of timbers required and sent one of his engineers named DeSpain to arrange for delivery of the timbers. He obtained three carloads for his use, and we obtained one carload to be used in reconstruction of the Horse Creek Bridge across the Klamath River. I call that cooperation.

Sixth Army

The Sixth Army area includes the eight Western States. They are: California, Oregon, Washington, Idaho, Nevada, Arizona, Utah, and Montana. The Sixth Army presented a new type of approach in obtaining cooperation. Most of our dealings with the Sixth Army were with the military personnel. The first problem that we encountered was occasioned by the Army use of certain lands on the Monterey District of the Los Padres National Forest under special use permit.

The permit had expired, but the Army was allowed to continue use of the areas covered by the permit. They had violated one clause in the permit, which prohibited the firing of live ammunition on National Forest land. Due to the urgency of military operations in World War II, no particular effort was made to prevent further contamination of the permitted area. For some reason, the Army decided to have a permanent permit for the area

and wrote the Forest Service, through the Real Estate Office of the San Francisco District of the Corps, stating in no uncertain terms just what they were going to have. The communication was signed by a Colonel, and since I had been designated as the Forest Service representative to work with the Army and the Corps, I decided that a matter of such importance should not be handled through subordinate officers.

Accordingly, I made arrangements for a meeting between Lt. General Swing, Commanding General of the Sixth Army and his staff, Regional Forester Clair Hendee, and other Forest Service representatives. I still remember that meeting. As Hendee, Frank Jefferson, Gus Rickel and I went into General Swing's office, he and all of his aides (15 or so colonels and one brigadier general) stood at attention. None of the military people resumed their seats until the general had. He was an old-line, typical hard-boiled officer, and he reiterated in no uncertain terms just what the Army was going to have. Clair Hendee was always a diplomat, but I could see the hair start to stand up on the back of his neck when the general made such a positive statement.

The man who threw a monkey wrench into the General's plan was Gus Rickel, who at that time was Forest Supervisor of Los Padres. He made the statement, "But God damn it, General, we cannot administer the Forest areas under your plan." This resulted in quite a little confusion because the General was unaccustomed to *no*.

It was agreed that the Army and Forest Service would get together and work out a boundary between the Forest areas to remain under Forest Service administration and those areas of Forest Service land to be permitted to Sixth Army use. John Edwards, at that time of the Division of Lands, and William Shawler, of the Engineering Division of the Sixth Army called "Logistics Division," and I participated in several of their meetings, and we soon found that Shawler, who originally had the attitude of all Army people, soon recognized our problems and was instrumental to a large degree in changing the Army's viewpoint and plans.

We had several meetings with other Sixth Army commanders after General Swing's retirement and each more harmonious than the previous one. We proposed and exchanged lands, around 50,000 acres of National Forest lands that had been contaminated by artillery firings and about 45,000 acres of Army land. This proposal was finally consummated, and the Forest Service gave some lands that were of very little use from a multiple-use standpoint and obtained some very valuable recreation lands fronting on the ocean.

We had many other discussions, all of them harmonious through the cooperation of Mr. Shawler. He still is at the Presidio and assists the Forest Service in many ways. As I stated before, I was designated as the contact between the Forest Service and the Army, and at least two Regions obtained our help in getting certain of their plans and proposals approved by the Army.

The greatest advantage to a one-man contact was that if anyone in the Forest Service wrote to the Army and it came to Shawler's attention, he would immediately contact me to see if the correspondence concerning certain proposals had come to our attention.

There was no intention to limit any other Forest Service Regional activities but to provide a medium through which the Army and the Forest Service could discuss orally proposals and/or mutual problems. This arrangement worked out real well; for instance, the Forest Service decided to establish avalanche control in certain snow areas in the Sierras. The problem was to maintain points at which they could set up artillery to fire into the overhanging snowbanks and destroy this dangerous element. I called Shawler and told him what the problem was. He immediately put me in touch with the Sixth Army Ordnance Officer, and after a few discussions, we acquired several 75mm guns and live ammunition at no expense to the Forest Service. The same arrangement was made for Region 6, although it was not a different Army area. On another occasion, Shawler had heard what they were going to do about this, and through him, I got in touch with the officer responsible for the disposal of this surplus stock and also of the horse equipment. This officer told me an officer's riding group had requested that the animals be turned over to them for their riding pleasure. I prepared a letter for Regional Forester Connaughton's signature requesting that the animals and equipment be transferred to the Forest Service without cost because of our need for use in Fire Control operations. The transaction came transferring the animals and equipment to us. If it had not been for Shawler letting me know about this availability, we would have missed out on getting much needed stock. I cannot speak too highly in praise of Shawler and his method of cooperating. He still cooperates in any way possible. I could write pages on this subject. In the beginning, the Army was inclined to think only in military terms. It wound up working cooperatively in facilitating programs that were in the best interest of "all the people."

Bureau of Reclamation

We had many dealings with the Bureau of Reclamation, most of them involving cooperative agreements between our agencies, primarily for the purpose of obtaining recognition by the Bureau of our needs in connection with relocation of Forest Service improvements to be inundated by reservoirs proposed or under construction by the Bureau. In the early days, there was considerable feuding between the Bureau and Corps of Engineers, mostly generated by local people endeavoring to obtain the best deal possible in connection with construction of water control or use projects. At the beginning, the Bureau was primarily interested in irrigation projects; the Corps of Engineers, projects for control of floods. It must have been quite confusing to both agencies to realize that proponents of various water control or use projects often switched from backing one agency to the other agency when projects were initiated in Congress for authorization and appropriation of funds. A few years later, these two agencies began to get together, realizing that projects for flood control were also useful for irrigation and water conservation. Projects for irrigation were also useful in the control of floods.

At the present time, I think that the two agencies work together very harmoniously. Two other phases came into both flood control and irrigation projects: maintenance of streamflows to provide releases for the fish population and recognition of recreational requirements that began to assume considerable importance.

Over a period of years, we had dealings with many of the key personnel of the Bureau, ranging from Regional Foresters to staff personnel. Some of the principal ones with whom we had dealings were Clyde Spencer, an engineer who was responsible for the construction of the Trinity River Project; W.J. McCrystle, Regional Engineer; Alex Pesonnen, who was responsible for land-use activities; Murray and Sullivan, Assistant Regional Directors; and others. Although we did have contacts with the Regional Directors, I have named only the men who participated closely with us in the consideration of our mutual projects and programs.

When construction was authorized, funds made available, and construction initiated on the Trinity River Project, it became apparent that the Forest Service would have to get into the picture, necessitating the Bureau to provide funds for relocation of Forest Service improvements, replacement of recreational facilities, and augmentation of recreation installations to take care of the needs of an anticipated large increase in recreational use of the National Forest areas on the shorelines of the reservoirs. Also, with increase of recreational use, there was need for increase in fire detection and protection facilities occasioned by the greatly increased number of people who would be occasioned by the availability of the additional recreational areas.

There was also need for an interim program for Fire Control because of the potential increase in fire occurrence occasioned by the large number of construction personnel in or about the reservoir areas. The matter of streamflow releases worked out separately for maintenance of the fish population was between the Forest Service, Division of Range and Wildlife Management, the State Division of Fish and Game, and U.S. Fish and Wildlife Service of the Department of the Interior.

Our principal concern was, of course, items I first mentioned. Having been advised by Region 1 of the difficulty of negotiating agreements with Mr. Spencer during construction of the Hungry Horse Dam in Montana, it became apparent that the best way to enter into agreement was to state our problems and what was needed from the Bureau to meet our requirements. After consultation with Forest Service divisions and the Forest concerned, I prepared a tentative Memorandum of Agreement covering the various items I have listed previously. This was duplicated and copies sent to all divisions and the Shasta-Trinity National Forests and to the Bureau of Reclamation.

It was a worthwhile undertaking. When we transmitted copies to the Bureau, we suggested a tentative date for the Bureau to meet with us to discuss the proposals and items covered by the draft of agreement. The meeting was held in the Forest Service Conference Room, and after about an hour and a half of discussions, agreement was reached on all items in line with our proposals. The only item discussed was Fire Control requirements during construction of the project. If the Bureau had not had a concrete statement from us of what was required, the meeting would have lasted at least 2 days and then not been completely consummated.

On subsequent meetings with the Bureau to discuss minor items in connection with the agreement, we had no difficulty in obtaining Spencer's acceptance of our proposals. He was the type of engineer who liked to get things done. He was outstanding in this respect. I have mentioned this agreement in some detail because it points a way to obtain cooperation from

other agencies without terminable discussion. We had many discussions with the Bureau on other proposed projects and after consummating our agreement on the Trinity River Project, we had a most successful and amicable consideration of our needs.

Soil Conservation Service

I have given you an idea in my discussion of the USDA Flood Control reporting phases of our relationship with the SCS. The final amicable relationship generated under the Flood Control Surveys Program continued and became even more favorable.

In discussion with the SCS on problems of mutual interest, there were several individuals in the SCS agency with whom we had contact: Charles Pettit, Assistant Regional Director in Berkeley; Stan Crosby, an engineer with the Service; Bob Cozzens; John Johnson; and later John S. Barnes, State Conservationist.

At the time of my retirement, instead of the original attitude of "Dog Eat Dog," the atmosphere changed to "Live and Let Live," an understanding that recognized that what each agency was trying to do was to improve conditions for all of the people.

Federal Power Commission

In the early days of Forest Service Engineering, the District or Regional Engineer represented the FPC in California. From time to time, Washington Office members of the FPC were detailed to the Forest Service to assist in preparation of the many engineering reports required by the Commission on ongoing or proposed projects. The reports covered in detail the engineering feasibility of projects proposed by the power companies.

It was in Frank Bonner's time, as District or Regional Engineer, that the load became particularly heavy. Ed Kramer, during this period, as Frank Bonner's assistant, was responsible for this activity. When Ed was promoted to Regional Engineer, John Beebe took over this job and, as usual, did an outstanding job because of his ability to talk with people without assuming that his position gave him any authoritative prerogative.

After the first stages of the Depression time, the FPC set up a regional office in San Francisco and Ed Kramer became the first Regional Director. The title of the position was later changed to Regional Engineer. When the FPC was organized here, the accounting job was turned over to a man by the name of Safeblade who was very well qualified to do the job, even though he remained a bachelor. After the FPC established its regional office, Forest Service participation was limited to checking on whether or not the power companies were abiding by the terms of the license and how their operation affected National Forest activities. We had many discussions with the Commission personnel, generally with representatives of the power company involved.

In the early stages, many of these discussions were acrimonious, but after a few years, there were few arguments and few arbitrary decisions necessary. During this period, there were many consolidations of companies. The old Snow Mountain Water and Power Company became the property of PG&E, and I believe the Southern Sierras Power Company became a property of the Southern California Edison Company.

Our dealings were principally with PG&E because it was in the northern California area that most of the power projects involving use of National Forest lands were located.

This company designated a public relations man, a Mr. J.O. Burrage. He was a very good representative for the company and really worked with us to try to negotiate satisfactory settlements of any disputes. When he retired, Bob Johnson was appointed to do his work.

I always felt that Bob Johnson should have been a member of the State Department or at least of the Diplomatic Corps. It occurred to me that in all of my recollections of him he was immaculately groomed and acted and talked like a statesman. But, if you knew Bob Johnson you could readily discern when he was trying to put something over. As legitimate as it might have been to the company, it did not get very far with the Forest Service Engineers who knew him. He was a very good cooperater who knew what he was talking about, and if you did not realize there were two sides to a question, you would have readily gone along with some of the proposals he made, which would not have been advantageous to the Forest Service. He was, and I think he still is, a good loser, but he did his best to get his company's ideas and proposals accepted. He was, and still is, the proper representative of the company in discussion with Federal, State, and local agencies.

We had quite a few dealings with "Heine" Lutge—I think he was the Chief of the Engineering Branch of the Company. That position is now occupied by John F. Bonner, previously referred to as a member of our bridge organization in the early days.

Incidentally, a coincidence during World War II—both John and Frank Bonner were Lt. colonels on active duty with engineering units of the Army.

Another member of the FPC, Robert F. Griffen, previously a topographer with the Forest Service, was subsequently with the Commission on the St. Lawrence River waterway. I have good reason to remember about Griffen. One day in November 1932, I planned to make a survey of a bridge site at the Jordan Creek Crossing of the Kern River. We started out on rented animals from Camp Nelson on a dreary day. We had been advised that it should be easy for us to make the round trip and the bridge site survey in 1 day. Unfortunately, we were misinformed. The distance of the trip was much greater than anticipated, and we did not arrive at the bridge site until about 3:00 p.m. that afternoon. By the time we had eaten a light lunch and completed our survey, it was about 5:00 p.m. and darkness was falling rapidly. Before we got up to Trout Meadows, it was so dark that the only way to keep on the trail was to see the difference between the shades of darkness. These were animals strange to us so we did not know how much they knew of the country. We finally made it to a cattlemen's shack where

they kept a supply of grain and fed our hungry stock. It was bitterly cold so we appropriated the horses' saddle blankets and put them around our shoulders to get a little warmth into our bodies. At first light of dawn, we got up, saddled the horses, and moved on to the trail en route to Camp Nelson. When we crossed Trout Creek, we had to watch our step because the creek was frozen solid and our horses skidded around quite lively. I am sure Bob Griffen remembers this trip since he has mentioned this several times. He was just as happy as I was to get back to the car so that we could get some place where we could eat and thaw out. He later became Assistant Regional Engineer of the FPC in San Francisco, a position I think he still occupies.

I mentioned previously that Bob Griffen was with the topographic unit of the Forest Service. He was one of several recruited by Theron R. Littlefield, who had been appointed as Chief of Surveys and Maps Branch, to replace Sid Stoner, who had resigned to accept a position as city engineer of the fast-growing town of Tampa, Florida. Some of the other Engineers recruited by Littlefield included L.B. Lint, C.A. Davidson, Roger Amidon, W.J. Leonard, Carson, and Cammerling (I cannot recall the latter two names).

Littlefield was in the field checking with Bob Griffen on surveys he was making. Bob got an acute attack of appendicitis. Littlefield took immediate steps to get him to a doctor, and although Bob's appendix ruptured before he got to a doctor, he got there in time for the surgeon to operate and avoid an almost always fatal attack of peritonitis. You might say that TR saved Bob's life by his quick action.

Littlefield had been in the Forest Service prior to World War I and was a member of the forestry engineering regiment in France. I think that he was also a hard-boiled first sergeant.

When he came back from overseas, he became a District Ranger in one of the western Regions. After serving as Chief of Surveys and Maps here, he was appointed to a position in Engineering in charge of water power, water resources, and related activities. His section later became known as Watershed Management until the Division of Watershed Management was organized subsequently. TR, as most of us called him (some of them called him Ranger), did an excellent job in this new position. Cooperation with the power companies and State agencies was well taken care of by TR and his associates. It was through his efforts that many negotiations with the power companies, Federal Power Commission, and State agencies were successfully concluded. He is a man who will be well remembered for his methods of approaching some very difficult problems and obtaining most satisfactory solutions thereto.

Ed Kramer stayed as Regional Director until his death, which occurred following an operation. John Beebe was selected to take his place, and it was at that time that Tony Dean came into the job as Regional Engineer.

National Reclamation Association

The National Reclamation Association is an organization primarily of irrigationists, although they consider all phases of water use and control. It is comprised of representatives of the 11 western States. Each State is allowed

one member to serve on the Board of Directors. The President of the Association is elected annually at a convention held in one of the member States. California, with its many water use and control projects, has always taken a prominent part in discussions at these conventions.

Generally, there is a program on which selected speakers of national prominence in the field of the Association activities are scheduled. Each State, prior to the meetings to discuss resolutions proposed by the States, has what they call a "State Caucus." This caucus holds discussions concerning resolutions that the State should support in the meetings of the Resolutions Committee of the Association.

The Forest Service has generally been represented at the annual convention and, because of my association with the various water people in the State, I was generally designated to attend. At some conventions, the Regional Forester attended. At times the convention assumed sufficient importance for the Secretary of Agriculture to send a personal representative, generally, the Assistant Secretary of Agriculture.

Prior to the date of the convention, the Irrigation Districts Association of California holds a meeting, at which time resolutions desired to be included in the meeting of the California Caucus and the convention are presented and discussed. Many resolutions accepted by the Irrigation Districts Association were submitted to the caucus; however, many submitted to the caucus did not go through the Irrigation Districts Association meetings. The Forest Service had several proposals, most of them primarily in connection with the research on water use and water production. We generally had no difficulty in obtaining the California group's approval of recommendations.

In our attendance at the California Caucus, we were prepared to elaborate on our proposals and tried to secure the agreement of the caucus for inclusion of our programs and proposals and submission of them to the Resolutions Committee.

The resolutions are then considered by the Resolutions Committee of the National Reclamation Association. Again, many of our proposed resolutions affected water use and control activities of other Regions, many of which sent representatives to the convention.

In the early days, the conflict between the Bureau of Reclamation and Corps of Engineers became an important consideration in determining just what the Association would support. The Pine Flat project—that is, construction of a dam at Pine Flat and control of the flood water of the Kings River—was a focal point in some of their discussions.

As I remember, the Kings River Water Association originally wanted the construction of the Pine Flat dam by the Corps of Engineers, and then through discussions with the Bureau of Reclamation they temporarily shifted their support to the Bureau's proposal. They finally wound up supporting the Corps of Engineers' proposal with the agreement that irrigation phases of the project would be worked out jointly by irrigationists, Corps of Engineers, and Bureau of Reclamation. A man who had a large part in these discussions was Charles Kaupke. Besides being the secretary of the Kings River Water Association, he was water master. In other words, it was his job to

see that landowners downstream secured the amount of water and at the times designated by local agreements and the State Water Rights Board.

The president of the Kings River outfit was a man named Boone, who was an old timer and knew the many problems concerned in water use. As I stated previously, the Resolutions Committee did prepare a list of proposals that the Committee had approved and submitted them to all the members in general session at the convention. Very few of these resolutions were defeated by the general membership. But I know of no instance when a resolution, not previously considered by the Committee, was adopted by the convention. Those resolutions requiring action of the U.S. Congress for their accomplishment were assigned to the Legislature Committee, whose duty it was to try to get them approved by Congress.

During my time, very few of these resolutions required and few of them received congressional approval, but it was a good try and at least it brought to the attention of all members of the Association that they were working together toward a common goal. Water rights played an important part in the discussions of the membership. Many of the members felt that the Forest Service should not claim rights to the use of all waters originating on National Forest lands. In some States, particularly in the Southwest, discussions on this subject at times became acrimonious. Perhaps, since my days, the Association has become more successful in obtaining action by Congress on resolutions agreed to by these memberships.

State Agencies

Cooperation with State agencies began early in the history of Engineering activities of the Forest Service. In the early days, most of our activities were in connection with the State engineers' activities. The State engineer who I remember as an active cooperator with us was Edward Hyatt. He was in responsible charge of all State activities pertaining to the use and control of waters from California streams; and his office also cooperated with the topographic branch of the USGS in a program of topographic mapping of various areas in California. Later, the Office of State Engineer was abolished, and it became the Department of Water Resources with Ed Hyatt as the Chief Engineer.

State Department of Water Resources

Cooperation became most intensive during the time that Frank Bonner was Regional Engineer and Ed Kramer was his assistant. I have previously mentioned Ed Kramer's knowledge and ability on design of dams and his work in connection with review of designs for the constant angle arch dams. George Hawley was, at that time, engineer of dams. He and Ed had many discussions of dams and structures necessary for water resources development or control. This set up a pattern of cooperation between our two agencies, which has been maintained to this date. I believe that Ed Hyatt is considered as "Father of the Central Valley Project," a project for the planned development of water resources for power, irrigation, and conservation purposes.

At the beginning of the Feather River Project, our preliminary discussions were with Ed Hyatt. By the time the project was approved, Hyatt had

retired and Bob Edmonston was appointed in his place. The Feather River Project embraced many acres of National Forest lands in the drainage area of the watershed, including lands abutting the reservoir area behind the so-called "Oroville Dam."

We reviewed the State's project proposal, and it became apparent that there were many Forest Service improvements that would be inundated when the reservoir filled and that would need relocation prior to completion of the dam. We also realized that the project, when completed, would necessitate installation of improvements at many additional recreation areas.

Not having funds ourselves to make a study and report on Forest Service needs, we submitted our proposals to Edmondston for transfer to us of sufficient funds to prepare our report to him of just what we would request of the State. He recognized our situation and made funds available, which we used in preparing a detailed report of what we required. After review of our report, the State approved our request and paid for relocation of improvements, additional recreation areas and funds for fire protection requirements during construction, and increases as necessary because of increased fire hazard through additional recreation use after completion of the project. This was a most successful negotiation.

There have been many other projects on which we have worked with the Department of Water Resources to meet Forest Service requirements occasioned by construction of new projects under the State Water Plan. These discussions are continuing as the development of projects under the State Water Plan proceed.

Another cooperative project with the Department of Water Resources was the annual cooperative program for snow surveys. The Forest Service conducts the field survey for stations agreed upon and makes report to the snow survey organization of the State. This cooperative snow survey program had been carried on for many years under agreement with the State. Annually, there is a meeting of the State agencies responsible for conduct of snow survey and participating cooperators, which includes, besides the Forest Service, power companies, municipal water districts, irrigation districts, U.S. Weather Bureau, and others.

The field work of the Forest Service is generally under the direction of the District Ranger of the area in which the snow survey station is located. This had been recognized by all Forests and the Regional Office as a very desirable program.

Water resources are a continuing problem to adjudicate and administer in the State of California. Many worthwhile projects have had to be abandoned because of the inability of the proponent to show that he had rights to use the water and an allocation by the State Water Rights Board to streamflow and even springs to provide the amount of water annually to make the project feasible. It is a highly controversial problem and one most difficult to administer because of the hard feelings and extreme jealousies set up by claimants to the same source of water supply. This is true not only in California but in many of the Western States. So far, the State has been able to administer the water resources annually without combat or feuding between claimants.

State Water Rights Board

The State Water Rights Board, at the time of my association with them, was composed of a chairman, two members, and an executive secretary. The responsibility of the State Water Rights Board is to determine who has rights to use State water resources under the definition of the State Water Rights Act. This organization has a tremendous responsibility for seeing to it that water is used according to a claimant's legal rights to use it.

Water originating on National Forest lands in the watershed of a drainage area is not legally under the jurisdiction of the State Water Rights Board; but to ease the load on the Board, the Forest Service has followed the practice required of individuals or organizations desiring to use water by filing an application with the Board.

At times when water is in great demand, this arrangement makes it much easier for the State to administer the Water Rights Act.

Most of my dealings were with Lee Hill, the executive secretary, a man who knows the technicalities of administering the Water Rights Act and is a most hearty and able cooperator. With his help, we have been able to get out of situations that would otherwise have been almost impossible to live with if we had maintained the Federal position of immunity to the provision of the State Water Rights Act.

I will not enumerate the many instances where this problem of joint use of available water supply has been successfully negotiated on our behalf through the efforts of Lee Hill. In this connection, I want to bring out the excellent advice and assistance provided us by Jesse Farr and his staff. This passing word is but a slight token of what we feel about Jesse's assistance and leadership in this feud. He has solved several problems for us and is continuing to do so. Our praise of his work and efforts cannot be stated too strongly.

State Division of Parks and Recreation

When a State program for construction and maintenance of a State system of riding and hiking trails was approved by the legislature and funds provided for initiation of the program, the Forest Service recognized the value of a cooperative program in which the Forest Service would construct those units of the system on National Forest lands and, when requested by the State, construct and maintain trails that were on rights-of-way obtained by the State over a private land and to be reimbursed by the State for cost occasioned by this construction or maintenance.

The initial agreement under this cooperative arrangement was made on the Plumas Forest. After successful completion of sections of the trail system under this program, we prepared a master agreement to provide accomplishment of this joint program in line with the above arrangement for projects throughout the State.

I have heard recently that the State Riding and Hiking Trails Program is not receiving funds commensurate with the need for an orderly and progressive

program of construction of the originally planned trail system. I know that the California Horsemen's Association is trying to bring pressure to obtain sufficient allocation of funds to provide a reasonable degree of progress on construction and maintenance of the system. The Association might possibly throw a monkey wrench into the planned system by insistence on construction of trails in and around urban areas where the majority of horsemen would have access to satisfactory riding trails without traveling miles to get on one.

I have not seen, but there must be one under preparation by the Association, a plan for revision of the original map and program of riding and hiking trails throughout the State. There is also the problem of use of some of these trails by owners of jeeps and motorcycles. It is going to be quite a job to get a program adequately financed that will satisfy the needs of the hiker, horseback rider, and motorized vehicle user.

California State Chamber of Commerce

The California State Chamber of Commerce was originally called the California Development Board, and it appeared that their primary interest was collecting jars of preserved fruits and vegetables from various counties and exhibiting them in cases on the mezzanine floor of the Ferry Building. In 1920, primarily through the efforts of Norman H. Sloan, newly appointed manager, the name was changed to the California State Chamber of Commerce. The objectives were also changed. Sloan had been the Forest Supervisor of the Shasta National Forest when I first came to California, and it was he who loaned me the "use book," a small handbook that served as the directive for Forest Service activity and that has now been replaced by an 8-foot shelf of manuals. Reading this book gave me the knowledge necessary to pass the Forest Ranger examination. Sloan was a very able administrator. He had a dynamic personality and soon developed an excellent organization. Some of his assistants included Emmett Stewart, Director of the Natural Resources Unit, Frank McKee, Director of Highways, and Jerry Carpenter for Recreation. Most of my dealings were with Emmett Stewart, and we jointly considered and worked out the platform on which the association carried on its activities, in regard to participation with the Department of Agriculture on Flood Control. The State Chamber of Commerce is still active in many fields. I have not had any association with them since 1960, so I do not know how their efforts are succeeding at the present time. Many influential California men were active in the association and gave leadership through their board of directors toward accomplishing programs beneficial to the State.

This was a quasi-public agency. To the best of my knowledge, it was never subsidized from Federal or State agencies' funds.

Just Rambling

If after reading this narrative you think that I have been rambling, just wait until you read this.

First of all, I have a very deep regret that I could not include in this narrative the names and accomplishments of many people within the Forest Service with whom I was associated over the period of 42 years.

I started to make a list of names of people to whom I would give credit for the steady advancement of the Forest Service, its activities and principles of performing their duties toward the "greatest good for the greatest number in the long run." I do not remember who coined this slogan, but it was a very apt one and stated very well the principles under which the Forest Service had been operating for a long time.

In the beginning of my narrative, I stated that I would mention the names of very few women of the organization. This was not for lack of recognition of the part that they have played since the Forest Service started to function as an organization. They are the very lifeblood of the Forest Service—without them, we may as well fold up. Many of the women have outstanding records of achievements and dedication to Forest Service work and ideals. I have failed to mention them individually because of the knowledge that I attained over many years of the inherent likelihood of arousing an unintentional jealousy. To mention a few, and not all of them, would have been a rank injustice, and I would hesitate to set myself up as judge as to those who would be considered most important in the development of the Forest Service. This is my acknowledgment to them of just how important they were and are in the activities, programs, and development of the Forest Service.

In my narrative, I have mentioned my aversion to the use of the word "inspections" in connection with the review by teams designated to review activities and accomplishments on various Forests. George James and I, as stated previously, were assigned to cover the Mendocino Forest. In preparing our report, we decided to include a foreword deploring the use of the word "inspection" for this review. When our report was reviewed, the Regional Forester and others made no comment or reference to our preface to the report. It follows:

The report was originally scheduled to be completed in 1953. One week was spent on the Forest but completion was deferred because of the tragic fire occurrence shortly after our first week's visit to the Forest. Again in 1954, one week was spent on the Forest but it was found necessary to defer completion of the job because of an emergency which occurred in the family of one of the team members. Ten days were spent this summer completing the "On-Forest" review.

You probably noticed that we have called this a general integrating review rather than an inspection. We are recommending that consideration be given to so designating future general integrating activities for several reasons.

First, when we go on a forest on an assignment of this kind, we approach the job with the idea in mind of trying to assist the forest organization by review of the manner in which they approach and degree to which they accomplish the various phases of the job of administration management and protection of the forest resources. We actually do review their performance in various phases of the job making suggestions on the manner in which they may accomplish improvement in their performance where it is not up to standard and commenting where performance is outstanding.

Another reason for this suggestion is that we feel that rarely is a team fully qualified to inspect all functional activities. This is true even though at least one member of the team is expected to have served as a Ranger or Forest Supervisor

which supposedly would give him a broad background of Forest Service policies and activities. This is not necessarily the case since, for instance his experience may have been on a timber forest with very little water management activity and he may be a member of a team assigned to review the work on a forest with a very heavy water management load. Such a situation is not conducive to a full acceptance by the Supervisor and his staff that the team is fully competent to pass on performance in all phases of the job.

Another reason is the feeling that the word "inspection" automatically produces in the minds of many people, setting up to some degree a resistance, whether willful or not, to full frankness and participation in reviewing the forest performance. We have a feeling that a review report establishes a wholesome and friendly approach to assisting the forest to attain the highest degree of performance in the job.

We have approached this job with these thoughts in mind and in the following report have indicated only those points which are outstanding or those items which will take a period of time to bring performance up to standard. Accordingly, in the report there is no reference to those actions or activities which are now up to standard or which, if substandard at time of review, have been corrected prior to writing this report.

So much for that.

In my narrative of our participation with the Army, I made the statement that most of our cooperation was accomplished in discussions with and through civilian personnel for the reason that officers in command were at their station a short period of time, whereas the civilian personnel were generally on the job for many years. As an example, I will give you the following information furnished to me by Mr. Shawler, our chief cooperator contact. He is still at his desk, and he told me recently he did not know when he would retire because he has only 42 years' service with the Army.

The list of generals of the Sixth Army from the period 1951 through 1961 is as follows:

Sixth U.S. Army Commanders

Lt. General J.M. Swing	1 Aug. 51–28 Feb. 54
*Lt. General W.G. Wyman	Mar. 54–June 55
Lt. General Robert N. Young	1 July 55–30 Sep. 57
Lt. General L. Mathewson	1 Oct. 57–Jan. 58
Major General Robert L. Howze, Jr. Interim Cmdr.	Jan. 58–28 Feb. 58
*Lt. General Charles D. Palmer	1 Mar. 58–1 Oct. 59
Lt. General Robert M. Cannon	2 Oct. 59–31 Aug. 61

*Promoted to General in next assignment.

Major General William F. Dean was Deputy Commanding General, Sixth U.S. Army, from January 1954 to October 1955.

I have told you of Clair Hendee's and my visit to General Swing's office together with other members of the Forest Service and the type of reception we received. In 1954, Clair Hendee and I visited General Wyman to discuss various phases of the proposed Hunter-Leggett Forest Service land exchange. We received a "red carpet" treatment from General Wyman and were able to discuss points of mutual concern man to man. As a matter of fact, he and I found out we were both born in Washington, D.C. and had attended the same high school—although at different times. But there were several characters whom we both recalled, including the football coach and Louie Mattem, the rotund and jovial professor of chemistry.

At this same meeting, we met General Dean, who, you will remember, was the hero of the Korean War, having been captured and held prisoner for some time. He invited Hendee and me to his quarters after the meeting, and we had a very pleasant conversation with him and his charming wife. Dean was very much interested in the Forest Service. During the CCC days, he had been the Army commander of the Hackamore CCC camp on the Modoc. At that time, Fred Cronemiller was Forest Supervisor. Dean was interested in how he was and stated that he would like to see him. The chance came quite soon. The Forest Supervisors were having their annual meeting in San Francisco, and since they had not selected a speaker for their luncheon, I suggested General Dean. The Supervisors agreed that he was a good choice and so I made arrangements through my friend Shawler to get him to attend and be the guest speaker. I was scheduled to pick him up at the Presidio before the luncheon, but realizing the close friendship between General Dean and Fred Cronemiller, I relinquished my privilege to act as escort to Fred, and I am sure that they had mutual pleasures in reviewing old acquaintances and remembrances. So much for the Army.

No narrative of Engineering activities during this period would be complete without statement of the accomplishments of members of the Surveys and Maps unit. Charles "Don" Jackson was appointed from Region 2 to fill the position vacated by Littlefield when he was transferred to water activities. Jackson was a brilliant man in the field of map making. He had the ability to see the future trends in map making. Of course, we had long been engaged in preparation of basic Forest Service maps from available source material and topographic surveys by our own topographers under Jackson. Jackson figured that more accurate basic maps would be produced if they were made with the aid of aerial photography. Accordingly, contract was let for aerial photographic coverage of the Tahoe National Forest at an approximate scale of 1:24,000. Fortunately, we had obtained on Jackson's staff a man who had some photogrammetric experience. His name was Alonzo Hammond. He and Ted Sievers handled most of the photogrammetric work with excellent field control by "Tiny" Lint. This was the first topographic map produced at a scale of 1/2 inch = 1 mile by photogrammetric methods in the Forest Service. To this day, the map retains its acknowledgment as an excellent job, correct in every detail.

I do not recall whether Herman Sedelmeyer was still Chief Draftsman, but it was shortly after he retired that Wally Lund became Chief of Drafting. Jackson and Lint always explored possibilities of improving the accuracy of field control, experimented with and decided on the use of the "subtense" bar in measuring distances to control points. The procedure used proved very successful, and both of these men received a monetary award for this

accomplishment. Lint and Lund had under consideration the design of a plotter table to make the laying out of projections at a scale of 1:3,168 quickly and more accurately. These two men also received a monetary award for their contribution to the advancement of map making processes in the Forest Service.

Of course, there were many other outstanding achievements of this group, too numerous to mention in this narrative. I believe that the combination of Jackson, Lint, and Lund was generally acknowledged throughout the Nation as leading contributor to the science of map preparation and production.

I have not made any specific mention of the cooperation between the Forest Service and the Water Resources Branch of the USGS. This cooperation had been going on so long with such good results that I presume we just took it as a matter of course that we could rely on them to give us information that we needed, so that it became just a matter of acceptance that such excellent cooperation existed. When we needed specific information on streamflow data in drainages we had under consideration, we could always depend on getting the latest information from the USGS at such times as we needed it. I do have recollection of one man who headed the Water Resources Branch in California for quite a long time—his name was McGlashan, a most helpful cooperator.

Previously in this narrative, I have mentioned Herman Sedelmeyer. I told you that I first met him when we were both working in the Office of the Chief of Ordnance in the old State, War, and Navy Building in Washington, D.C. Sedelmeyer was a much better draftsman than I was. He was listed as a full draftsman and I was assistant draftsman.

Herman was born in Stuttgart, Germany, and came to this country to avoid conscription into the German Army; however, he had no hesitation at joining the American Army, I believe with a topographic battalion of Army engineer troops. He served during the insurrection in the Philippine Islands and I believe attained a rank of M/Sgt. Just how he joined the Forest Service, I do not know. I do know that he came out here to see the Panama Pacific International Exposition held in San Francisco in 1915. He became Chief of Drafting when Robert E. Lee Borgfelt had to relinquish the job due to a chronic attack of inflammatory rheumatism. In this connection, a little insight into the character of Fred Fowler might be obtained with the knowledge that he had arranged for the detail of Borgfelt to the Sequoia National Forest with station at California Hot Springs, which was famed for the medicinal properties of the spring water. The cure was not successful, but Borgie, as we called him, stayed on active duty with the Forest Service until he reached the mandatory 70-year retirement age.

Sedelmeyer maintained an excellent reputation for his drafting abilities and leadership of the drafting force in producing Forest Service maps. During the Depression days, he planned and organized a program for construction of relief models of all the Forests in the Region where adequate topographic maps were available. The job was done under the Works Progress Administration (WPA) authority. He had a crew of from 30 to 40 people working on the program and developed the ability of some of the people to a point where they could readily compete for positions in the drafting field. These relief models were built to exact horizontal and vertical scales. After a

model was made, and I am not going into details of their construction, a cast or mold was made of the model and copies could be reproduced by pouring plaster of paris or other materials into the molds. The finished product was then colored—roads, trails, boundary lines, and all other facilities were depicted upon the model so that at a glance one would get a true picture of the culture and relative vertical position of all items depicted.

Henry Klant was the man responsible for the finished product, and after all models were installed in the Supervisor's Office, it was his responsibility to maintain them and show current changes in the culture. These models were on display generally in the entrance area to a Forest Supervisor's headquarters. It still is a major point of attraction to visitors of Forest areas. I might add, for the benefit of those who are not familiar with the models, that they serve another purpose. On each peak or point where there is a lookout, a small light globe was installed. In a darkened room, when the lookout lights were turned on, it showed locations in the National Forest where feasibility was nonexistent or limited. This was a big help in fire control detection planning.

I could go on listing the many contributions Sedelmeyer made to the Forest Service activities. He was a man fairly small in status but large in stature.

Most of my readers probably knew Evan Kelley or have been aware of his accomplishments. During World War I, he was in command of a Forestry Regiment in France. His adjutant was none other than the redoubtable R.L. Deering, previously referred to. After his return to the United States, Major Kelley became the Regional Forester of Region 1 at Missoula, Montana.

Montana was a vast region with areas untapped by roads and, in some cases, trails. Firefighting in the mountainous areas became more and more difficult as human access to the backcountry increased. There were no helicopters in those days to transport men from centers of population to the remote areas where most serious fires occurred. In many cases, it was several days before firefighters could reach the fire line.

To reduce this time lag, Major Kelley established a remount station not far from Missoula where the Forest Service raised and trained horses and mules and used them in getting firefighters to the fire lines. Major Kelley organized a transport system of trucks, especially equipped for safe transportation of animals and men to the end of any road system. This system of providing forces and firefighting proved very successful and resulted in a greatly lowered acreage of burned areas each year.

At the beginning of World War II, the shortage of rubber and its products in the United States became acute. To combat this shortage, a program was organized in California to grow, harvest, and manufacture a rubber-bearing plant called "guayule."

Major Kelley was assigned as director of this project. The principal planting areas were in the vicinity of Salinas, although other areas developed in the southern part of the San Joaquin Valley. The first headquarters were established at Salinas, but later because of the magnitude of the project and the many planting areas, the headquarters were changed to Los Angeles. As the project developed, the name was changed to "Emergency Rubber Project."

J.J. Byrne was the Chief Engineer for the project, and it was due to his imagination, mechanical and electrical knowledge, as well as his administrative abilities, that the engineering phase of the project proceeded rapidly and with unvarying success. Many Regional Office personnel and personnel from other Regions were detailed to this project to speed up the many difficult and interrelated phases involved.

I had met Major Kelley several times, but I did not get to know the man until he was invited to accompany a group of Forest Service people on a trip to examine erosion problem areas on the Tahoe National Forest. The group included Reg De Nio, who at that time was Assistant Regional Forester in charge of the Division of Range Management; Forest Supervisor Gus Rickel, Tahoe National Forest; Ken Bradshaw, at that time soils technician for the Region, working in the Watershed Management Section of the Division of Engineering and Watershed Management; the District Ranger of the District involved (I cannot recall his name); and a Tahoe Forest packer. We made a 3-day trip but did not really get into the problem area because of heavy snowpack conditions. The Ranger loaned me the horse that he generally rode, and rode his second animal that had not received full training. As a matter of fact, shortly after we started out, the horse did not seem to think that the trip was worthwhile, so he bucked around and finally reared and fell backwards over a barbed wire fence. Fortunately, the ground was soft and the Ranger and horse were not seriously injured.

I had a big bay horse, strangely enough I can remember his name was Thunder but cannot remember the Ranger's. De Nio loaned me a stock saddle, which he had purchased from the widow of Walt Wetzel who was previously Chief of Range Management. I did not like stock saddles, and I particularly did not like this one, as it was specially built to Wetzel's specifications with a foam rubber cushion under the seat cover. It was easy riding but put you too far away from the horse.

Ken Bradshaw drew a horse that was a pain to him for the entire trip. He was what we call a "jigger." While all of the other horses walked, he would just jig like a hobbyhorse, and I can state quite truthfully that he was a pain to Ken, and I take my hat off to Ken for staying with it. He was pretty sore after each day's ride. Reg De Nio rode a big red horse, which he was planning to buy from Range Management funds and give to the Tahoe. He did a mighty fine job riding this not-too-well-trained horse. Later, I had the pleasure of riding this animal around the Squaw Valley Mountain area.

Major Kelley, an expert horseman, rode a little bay mare. Gus Rickel was riding a palomino, which I understand at that time was jointly owned with Hank Branagh.

The man who cooked our breakfast and called us to come and eat it was Major Kelley. He was a mighty good camp cook and for a man of advanced years sure did not show it. Major Kelley was a good camp traveling companion; he had many interesting stories to fire away the hours between supper and bedtime.

There are two men whose virtues and abilities I would like to extoll further: Anthony P. Dean and James J. Byrne. The virtues that I attribute to one are applicable to both of them. But to start with Tony, I believe that I told you I first met him when he was superintendent of a CCC camp on the Sierra Forest. When he came to the Regional Office, he succeeded John C. Beebe as Regional Engineer. He brought with him all of his ability, which had been demonstrated to limited degree during his period on the Sierra Forest. He was one of the most straightforward men that you will ever encounter. He had the ability to select a man for a job, know that he was qualified to do it, and let him do it without interference except to give guidance where it was needed.

I remember he told me once that if he gave a man a job to do, he would like for him to go ahead and do it. He liked to see a job done. He further told me that if a man did a job that he was assigned, came to a conclusion after due consideration of all factors involved, and turned out later that his judgment had been incorrect, that he, Tony, would assume that blame himself. This generated the utmost confidence in his supervision by engineers and others working under his direction.

His Bostonian accent was always enjoyable. I remember that many times when explaining a problem, generally involving finances or the distribution of funds to various activities, one of his statements was, "Now, you see this is the way it works." I wonder if many people realized that Tony was working under physical pain most of the time.

I heard complaints that in informal nighttime meetings, Tony would keep the participants up to all hours of the night. The reason for this was it was difficult for Tony to relax because of an acute pain in his back. He never complained, and I only found out about this by accident. My hat's off to Tony. May they build many more men to his stature.

As to Jim Byrne, he was another supervisor who would give a man a job with full confidence that the man could do it without undue supervision. He was always thoughtful and ready to assist in solving problems that seemed insurmountable.

I first met Jim down at Salinas; I previously told you he was Chief Engineer of the Emergency Rubber Project. I met him through Ed Meldrum, who previously worked on structural design with me. Ed was a good designer and always seemed to have a logical solution to any structural problem. Previous to his employment with us, he had worked with a copper mining outfit up near Kennett, outside Shasta National Forest. He suffered an accident, which permanently crippled him, but this injury did not detract from his ability or imagination. He is the first man I ever heard of to install two fuel systems on his private car. He would start the car with gasoline and then switch to diesel, which gave him great mileage at the lowest cost per mile.

Jim came to the Regional Office to take the position being vacated by Tony Dean, who had been transferred to Washington Office as the Chief Engineer of the Forest Service to replace the aging T.W. Norcross.

Incidentally, Norcross and I could never get together on one point; that was his desire that all structures built by the Forest Service be constructed of timber, and my practice of designing all permanent structures of structural steel. Other than that, we worked together real well.

Now back to Jim. I have previously told you of his installation ceremony at a dinner in San Francisco. Because of Jim's quiet manner and low, well-modulated voice, I introduced him as "Silent Jim Byrne."

We had many interesting years together, and together we accomplished many things for the Forest Service and the users of the Forest lands and their resources. I have no recollection of having heard him raise his voice in anger.

He had the full confidence, and still has, of all of the people working under his supervision and of Forest officers of higher rank. To my knowledge, he never returned from a conference with the Regional Forester and/or the Assistant Regional Foresters without accomplishing his well-thought-out plans and proposals. This ability to present problems and programs in a manner both understandable and acceptable is still with him in his present position as Chief Engineer of the Forest Service. May he continue in good health and in this position of leadership of Engineering forces and activities of the Forest Service for many years to come.

Soliloquy

General

After a person has worked for one organization for over 42 years, I think he is entitled to sit back and review the many phases of the work that he had been doing and come up with some suggestions for others that might possibly be of value to them in similar situations.

I have often heard it said that it sure is a sign of advancing age if a person looks back and talks about the things he has done and not about the things he is going to do. Admittedly, I am no longer a young buck and not physically capable of doing many of the things that I had done previously; for these reasons, I feel that I am fully justified in looking back since there is little likelihood of any interesting problems or projects arising that I could complete successfully.

In the discussion that follows, I want it to be understood that I am not moralizing the things that I recite. They are items that I recognize over a period of years as a desirable approach to do a satisfactory job, particularly in the field of administrative activities.

Safety

For many years, the word "safety" was seldom heard. Safety, as such, was only practiced through experience received while doing a job. In my latter years, I became quite a nut on safety and preached it by action as well as by words.

Up to the present time, I cannot go along with Joe Sonntag completely in the matter of the use of safety belts. I will readily agree the use of safety belts when traveling on major highways at high speeds is desirable. Their

use can save and probably has saved the lives of many persons sitting in the front seat of the car alongside of the driver.

I do not agree that safety belts should be worn when traveling on mountain roads, particularly on one-way roads. I have seen cars that have gone off the road over steep cliffs.

If a person were using a safety belt, even though it had a quick release system, it would be an impediment to him since it be far better for him to have an opportunity to free himself from a plunging vehicle without having to think of unfastening his safety belt.

Joe and I have not had a fight about this, but we each stick to our own conclusions.

There is another thing about safety, which I recognized on my trips to review engineering activities on the Forests; that is, a person who lives day in and day out with a potential hazard around him is seldom aware of its presence.

I found many instances of lack of safety precautions, particularly in connection with electric appliances. I will cite two cases: on the Mendocino, it was the electrical wiring to a sump pump. The cord at the plug was frayed. To disconnect the circuit, a person had to go down several wet steps. I understand that this poor connection had existed for several years, and since it had not caused any injuries, it was not recognized as a hazard.

Another instance was down on the flood control project. A form was being built for construction of a dam. This form required the use of many 2-inch by 4-inch studs, cut to exact length. To speed up the operation of cutting, the boy running the electric saw kept the motor running continuously and as he cut off successive studs, and would keep the machine running alongside his thigh. One little misstep or sudden distraction could have resulted in a severance of the leg or, at least, severe mutilation. Again, this was a case where the people had lived with this hazard, which had not resulted in an accident and did not constitute a hazard to them. This tendency to overlook a hazard when you live with it is a serious problem. It would be my suggestion that the safety program of the Forest Service include objective training in "seeing what you are looking at."

One method that I have found usable is to have the person go to a site of action where potential hazards had been planted, have him look at the situation and try to remember everything that was wrong or what was being done wrong or unsafely. Then make a list of them, and subsequently review photographs of the action he has been observing. After the picture has been developed, compare the items that he has enumerated against the actual picture to see how observant he was. It is amazing how many items will be shown in the picture that the average person did not see listed.

I was guilty myself of an incident that could readily have caused my death, but worse than that, the life of a beautiful young black horse that I was riding. This happened on the Sequoia Forest in the headwaters of the Kaweah River. The Forest Service was building a trail bridge up in the headwaters of the Kaweah River, and following my regular procedure, I

went out and saw how the project was coming along. The only way to get there was by a trail, so I stopped at a pack station and rented a horse. I was fortunate in getting a big, young, well-mannered black horse, and we got along famously from the start. He was willing and tireless. We had to climb about 4,000 feet, and during this climb, he never had to stop to blow even though he was traveling a good fast walk. I had to stop to make him rest several times. He never even got up a sweat even though it was a hot summer day. About two-thirds of the way up the mountain, one of those summer thunderstorms that occur in the Sierras hit us without warning. The rain came down in torrents, and we were both quickly soaked. The lightning and thunder accompanying the storm did not bother the horse at all. I realized that we should have stopped and hunted for cover away from the many trees in the area. Most of the trees had dead tops indicative of a severe lightning strike area. After about a half hour, the rain quit, but the lightning continued; as we gained elevation, we came out on a hogback. There we encountered blue fire, which I think is static electricity. I had experience with this blue fire on Solomon Peak on the Mendocino in 1922. It was my first experience with this phenomenon, and I sought to put it out, but as fast as I approached this flame, it would retreat and come up behind me again. I soon found it was useless to try to put it out. Well, we rode through this blue flame, lightning still flashing all around. It was a fool-hardy thing to do since his steel shoes made him an excellent target for a lightning strike.

I learned a lesson by this experience and certainly would not ride through a similar storm with similar conditions again. We were fortunate to get through safely. It certainly would have been a tragedy if through my neglect to take proper precautions, this beautiful animal had been killed.

Judging Other People

Judging other people is one of the most common and most annoying habits that we have gotten into. It is so easy to judge a person many a time on the basis of rumors alone. Many a promising career in the Forest Service has been stymied by ill-advised judgment based on rumor or hearsay.

Judging other people is a pernicious habit. To be competent to judge, you should personally know all the facts before you make any judgment. Perhaps if you follow such a procedure, you will find that you are not competent to make a judgment in a specific case. If you are not, then you should disqualify yourself and turn the job over to someone who does know the facts and is not influenced by unverified rumors pertaining to the individual under judgment.

One of our official judging contests is in connection with giving efficiency on performance ratings. These ratings are mainly based on opinion, unless there is some definite yardstick for measuring the efficiency or performance ratings of the individual. Then, too, these ratings are affected by several things.

I think the most common of the judgment errors is the personal feelings toward the individual being rated. Sometimes he is in the favor of the rater and the other times in his dog house. Some raters are very inclined to give the individual being rated the benefit of the doubt. This, I think, is

desirable, particularly if the rater is not personally acquainted with the work that the individual has been doing and his actual performance in the job.

Some raters are very severe in their rating, which makes for considerable confusion in comparing the efficiency or performance of the individual under a different supervisor than a rater. Then, too, there has not been any yardstick set up for rating raters—one against another. I think there should be a system established so that the general characteristic and procedure for rating the raters could be compared so that the final reviewing officer could have a more exact basis upon which to make a determination of the validity of the rating made.

This subject has been under discussion many times, and it is probably approaching a more rational consideration of the qualifications and performance of individuals. To me the simplest procedure would be to have three categories: outstanding, satisfactory, and unsatisfactory.

A detailed rating should be made of those individuals who are apparently outstanding or unsatisfactory. The majority of people would undoubtedly fall in the satisfactory class and would require no extensive rating. Persons getting unsatisfactory rating would naturally be subject to action for separation unless subsequent work in a grace period improves their rating. I think this period should be 6 months. I do not set myself up as an authority on this subject, but having had many years of experience in this rating game, I have learned many things that to me do not appear to be ethical. I might mention there is a tendency of a rater who is superior in the field in which the individual is being rated to judge his performance against his own. In other words, if the rater is a perfectionist, he has a tendency to underrate others under his supervision who do not approach his own ability.

Tolerance

The attitude of supervisory personnel, particularly in the top level, toward employees working under their direct or indirect supervision is a prime factor in the success of their conduct of Forest Service activities. Everyone in the organization is a cog in the wheel of successful accomplishment of goals set up for the organization and administration; particularly those in higher grades should realize this. Too often, the person in a very subordinate position does not receive the recognition for his loyalty and work accomplishment that he should receive.

Some administrators apparently do not see the need to know all of the people working under their supervision. You noticed I did not say "working for them," because they are not. They are all working toward a common goal; some, of course, much more dedicated than others. I have known two Regional Foresters who I think qualify as outstanding in recognizing employees under their supervision. The two I have in mind were Pat Thompson and Clair Hendee. They did not hesitate to spend some time talking with personnel in subordinate positions. This raised the morale of all the Regional personnel.

For Engineering, I would nominate John C. Beebe, Tony P. Dean, and Jim Byrne. I have known Max Peterson for many years, and he impressed me with his ability when he was on the Plumas and on the San Bernardino. Naturally, since I am retired, I have had no official association with him

since he has become Regional Engineer. But judging from what I have seen, I think I am qualified to say that he will soon fall into the same classification with the three Engineers mentioned.

I worked with and under the supervision of one Regional Forester who started out fine, but when he left the Forest Service for a higher position, I got the feeling that he had arrived at a point where his motto appeared to be "do as I say and not as I do."

In the Matter of Pride

It is an old saying that "pride goeth before a fall." This is completely erroneous. Pride is a very desirable trait or attribute for anyone. Pride is in accomplishing a difficult job, in the work of others, and in the general accomplishment of the organization. A person who does not have this feeling of pride is like a man without a country; without it, he would be a dud. On the other hand, conceit, which is sometimes mistaken for pride, is a very undesirable trait or characteristic and generally leads the person who is afflicted with this trait to become a braggart and by the same token a bore. Such a person does not hesitate to let any and all of his listeners hear of his accomplishments, if any, just for the momentary satisfaction of impressing his accomplishments upon his listeners. This matter of pride, particularly pride in the organization where one is employed and in fellow workers in the organization, leads to an esprit de corps, which is very desirable and a tremendous lift to the morale.

A Working Man Speaks

I would like to share an article, which follows. It appeared in the *San Francisco Examiner and Chronicle*, March 10, 1968. I have heard several philosophical statements by this man and often wondered if he has a "ghost-writer." After hearing him on a television program a few nights ago, when he was being interviewed, it was quite apparent in his answers that he was not reciting from a prepared script, since the many times he was speaking his head was turned away from any prompting board. This is an example of a man without any formal education who through reading and observation has developed his philosophical ability. Working with others in a group of longshoremen also helped him work out philosophies that in the greater part were very acceptable. The accompanying statement is to my mind a very astute one and applicable under most any conditions involving supervision of others. His statement is as follows:

Sunday Thoughts

by Eric Hoffer, San Francisco's Longshoreman-Philosopher

Freedom is incompatible with excessive supervision. No social order will remain free if it requires minute supervision as a safeguard against dishonesty and incompetence.

Excessive supervision usually bases itself on the assumption that human beings are incurably lazy, dishonest and incompetent.

Thus in regimented societies, whether of the left or of the right, there is likely to prevail a dark view of human nature. On the other hand, where wages are so high that excessive supervision is too expensive it will be profitable to operate on

the assumption that human beings, when left to themselves, are on the whole fairly decent and competent.

In such a society the prevailing view of man's nature is likely to be optimistic.

Finale

The foregoing statements that I have made are based on my personal knowledge, with the exception of those instances when I have stated otherwise. Such few exceptions are based on statements made to me by others. I certainly enjoyed working in the Engineering Division of the Forest Service and, with increasing responsibility over the years of my employment, the recognition of just what we were accomplishing toward the goal of "the greatest good for the greatest number in the long run." I only wish it had been possible for me to continue to work until mandatory retirement age. I might add that the 42 years I spent with the Forest Service passed by very rapidly. I presume that is why I can remember what occurred so many years ago. So I am closing this narrative with the hope that the Forest Service will continue to maintain its reputation for integrity and service.



Middle Fork, American River, Ponderosa Way, 1934. (This is a steel suspension bridge having a main span of 200 feet. The Construction Engineer was E.R. Huber. This is the first bridge where we used steel beams instead of trusses for the stiffening. The beams were 2 feet deep and worked very well and provided easy construction.)



Ishi Pishi Bridge, Klamath River, Somes Bar, 1935. (This is a steel beam suspension bridge having a main span of 200 feet. H.P.M. Birkenbine was the Construction Engineer. This was our second use of the steel beam for bridge stiffening. This is a modification of the tower portals. Our modification of the previous gothic arch design and the esthetic treatment did not materialize, increasing the cost of the fabricated steel.)

I extend my thanks to all of the Regional Office personnel who have helped me prepare this narrative and accompanying pictures, especially to Marina G. Camia, who in spite of having to do her regular job has contributed so much by taking my dictation.



A beautiful verdant spot in Emerald Bay. (For the sake of our Irish friends, I would like to say that this is "Emerald Isle," but it is not. It is named "Fannette Island," possibly by some lonely topographic engineer. How else can you explain it?)



Lumsden Bridge, Tuolumne River. (This bridge is a Warren truss with inclined chords and a main span of 85 feet. The Construction Engineer was "Red" Anthony. This bridge replaced one of the last covered timber trusses, which were a favorite type of construction in the Gold Rush days. This bridge gained a little notoriety since it was used and "destroyed" in the filming of the motion picture For Whom the Bell Tolls. When they exploded dynamite under the false covering that they placed on the bridge, it certainly looked as though the bridge was "destroyed." Naturally, it was not.)

Forty-Six Years Ago—And Later

Henry M. Shank

In undertaking to write a sketch of Engineering history in the Forest Service, which might well be termed "an autobiography of people and organization," I recall something a great-grandfather wrote that seems apropos. He wrote: "The following memorandum relates to an uneventful and comparatively obscure history. The instruction conveyed by autobiography does not so much depend upon eminence of the subject as upon fidelity of fact." Since this is essentially biographical both as to me and to the Forest Service, it may become burdened with first person singular, something that cannot be entirely avoided. If so, the indulgence of the reader is solicited.

I threw in my lot with the Forest Service on May 9, 1921, quite by accident. The postwar recession of 1920–21 had thrown thousands of men out of work, of which I was one. I saw in a Post Office a notice of examination for "Surveyor-Draftsman," U.S. Forest Service, Ogden, Utah, District 4 (later Region). I took it and passed it (barely, as I recall) and then made a call at the District (Regional) Office to inquire into prospects. Tom Lom-masson, a buddy of mine in World War I, was a "Grazing Assistant" in this office. He introduced me to Marshall Wright, who later went on to the Chief's and Secretary's office, was Chief of Maps and Surveys, and was getting under way a program of mapping the District (hereafter will be called "Region"). Upshot: I got the job.

The Regional Office was something less than impressive at that time, as was the size of the organization it housed. It was a three-story converted warehouse in the slummiest of Ogden's slum area, near the extensive railroad yards. The total organization was about as follows: "Dick" Rutledge, Regional Forester and "Clerk" (secretary); "Chet" Morse, Chief of Silviculture, one assistant, and one clerk; Ernest Winkler, Chief of Grazing, three or four "Grazing Assistants," and one clerk; "Bish" Gary, Chief of Lands, and one clerk; C.N. Woods, "Old Granite Face" (not a term of opprobrium by any means), Chief of Operation, Charley Simpson, Assistant, two clerks, and one mail boy; a man whose name is not recalled as Chief of Fiscal Control (he wasn't called that) and four or five clerks; a Solicitor (law officer) who borrowed a clerk when one was needed; Fred Baker, Chief of Public Relations, and one clerk, shared with the Solicitor; Joe Martin, Regional Engineer; Frank Ryder, Administrative Assistant, and one clerk; Marshall Wright, Chief of Surveys and Maps; Don Jackson, Chief Draftsman; Charley Truscott, Homestead Entry Surveyor; Theron Littlefield and the writer, Surveyors, and three draftswomen, Inez Corn, Rosalie Holberg, and Mary Malan; and Ernest Lubeck, Blueprinter. Frank Haynie, Supply Officer for the entire Service (pencils, paper clips, etc.), with his force of two printers, one clerk, and two freight hustlers, occupied the entire first floor, so that the Regional

Office proper occupied about as much space as does an average-sized Ranger District now (1967).

As far as can be recalled, the entire Region owned no more than two or three passenger cars, and there were none on any Forest—they were lucky to have one or two pickups or small trucks—war surplus. Few Supervisors acquired passenger cars before CCC days (1933). Travel was by train, personally owned auto (3¢ a mile), or horseback, the last being the only way for most ranger travel due to lack of roads. There was no powered road equipment in the Region. Small road graders were horse-drawn, and together with fresnoes and slip-scrapers were basic road construction equipment. Rock drilling was by single or double jack. The first compressors and jackhammers came into use about 1926 or 1927.

The preceding detail is set down for the benefit of anyone who wants to contemplate its significance (if any) in terms of 45 years later.

There is a temptation to reminisce and tell some memorable stories about some of the people mentioned, but since this is about engineers and engineering. . . .



Single jack drilling crew on Challis National Forest, Idaho, 1923.

Joe Martin, Regional Engineer, was a redheaded, short-tempered Irishman from Lehigh University. He was sharp as a tack, analytical, and irascible as a rattlesnake when his ulcers were giving him trouble. He could deliver a scathing rebuke in as few words and as impassionately as anyone I have known. I've experienced them. But it was excellent training and discipline (for me). He was utterly intolerant of sloppy work—another good influence for subordinates. He died a dozen years ago.

Marshall Wright, my immediate superior for the first 3 years, was a mild-mannered, pint-sized, true scientist, and one of the finest leaders I've known. He went on to become one of the early leaders and authorities in the United States on mapping from aerial photography. He still lives in a suburb of Washington.

Theron Littlefield transferred to Region 5 and became a water and power expert. He still lives in Berkeley. Mae Gilman, who for several years was engineering clerk and later became what is now designated as administrative assistant (actually, if not in name), probably occupied the same position in Engineering longer than did any other person in the Forest Service. It was her entire career. Rosalie Holberg, one of the draftswomen previously mentioned, has the distinction of being one of the very few living people (possibly the only one) who came West when the Forest Service was decentralized and most of its personnel moved to the several Western Regional Offices. She lives in Bellaire, Texas.

Any former resident of Ogden, Utah, can testify that smog is not a new phenomenon. Before diesels came into common use, most locomotives were coal burners. Ogden, being a large rail center and situated in a pocket in the mountains, got the full benefit of this coal smoke. Don Jackson, who was working on a base map tracing, came to work one morning and found a large lake on the map at a place where there was support to be no lake. Closer examination indicated it to be a large blob of soot from the railroad yards.

My first job was transit-stadia control for a timber survey on the Minidoka, starting from the point where Utah and Nevada corner on southern Idaho. Ray Garver was Supervisor—not long afterward transferred to Washington where he still lives—and J.W. ("Stoker") Stokes was Chief of Party. The party went by train from Burley, Idaho, to Rogerson, which was then the end of the line, about June 1, 1921. Thereafter the party traveled by wagon for the next 5 months with the Labor Day holiday of Sunday and Monday off. It was strictly a 6-days-per-week job and 7 if occasion called for it. Thornton Taylor, fresh out of Yale and with a Boston accent, was a member of the party and had never before been west of the Hudson River. He endured much from other members of the party. He went on to be dean of the School of Forestry at Utah State University and later became a wheel in SCS.

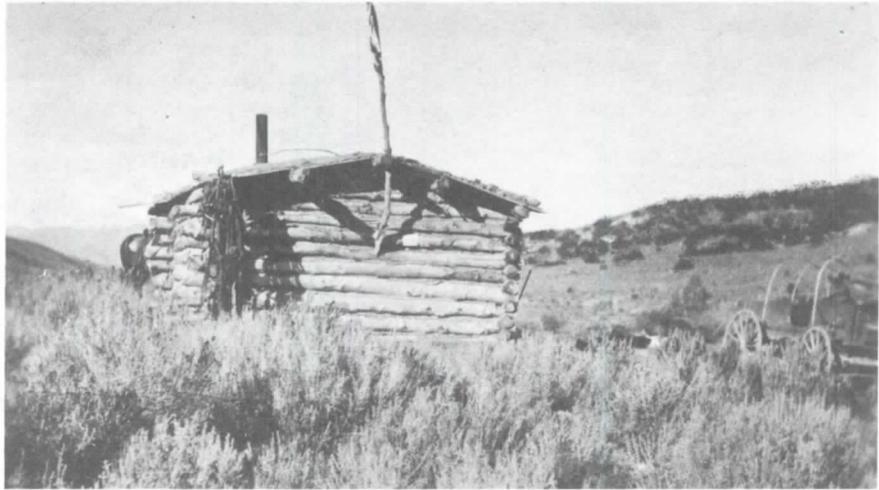
Stokes was (is) a grand guy and is still enjoying life. He spends his time getting around the whole world and the out-of-the-way places. Other members of the party stayed in the Forest Service for not more than a year or two.



*Timber survey party's golden chariot,
Minidoka National Forest, 1921.*

That summer must have been one of the wettest in Idaho's history. We were continuously wet until mid-August. That bred the most abundant crop of ticks ever seen. They literally swarmed on us, and despite all precautions, I developed tick fever—the spotted kind that in those days was fatal in more than 50 percent of cases. Treatment: whatever was in a small emergency kit—probably aspirin and iodine. I was too sick to move and too far in the sticks to have a doctor come out. So I toughed it out. The crowning punishment was that as soon as I was able to sit in a saddle, I had to ride 40 miles to get a doctor to certify for leave purposes that I had been sick! And then ride the 40 miles back under a broiling sun.

I spent half the winter in the Supervisor's Office helping compile and analyze the timber survey data. The only incident of note was a hassle between Garver and Joe Martin over paying me \$2.00 per diem while on detail. Joe won out. My pay at the time was a magnificent \$1,860 per year.



Magnificent accommodations for timber survey party, Minidoka National Forest, 1921.

I've often wondered how the timber management plan resulting from this survey panned out, for it was almost impossible to keep a pencil sharp enough so that lines delineating the patches of timber would not exaggerate size. I'm virtually certain that as a result of this the estimates were in error on the high side.

Early in 1922, I returned to Ogden, learned to make polyconic projections, and prepared plane table sheets on which I was to provide the control for a "grazing" reconnaissance on the Fillmore (now Fishlake). Jim Stewart was Chief of Party, the other members being Tom Lommasson, Mike Deming, Harley Helm, and George Craddock. All of these (except Helm, who died not long afterward) are widely known both in and out of the Service. I saw Stewart only once during the summer as I worked in a separate camp and ahead of his party. In fact, except for my cook-packer, I think I saw no more than half a dozen people for 6 months. Marshall Wright visited me to see that I was getting off to a good start, and after that it was only a chance and rare meeting with a Ranger.

That perhaps was the outstanding thing about Forest Service administration (or lack of it) in the early days. It seemed to operate on the English Admiral's injunction: "England expects every man to do his duty." It couldn't help but develop strength of character and purpose in men, and quite possibly the Forest Service could do with more of it now. I can't recall much harm ever coming out of it and surely there was much good.

Helm and I had to pack out into the field from Richfield. (The packer was to meet us from the other side of the mountain.) Neither of us knew the difference between a sling rope, and a lash rope, and the populace must have had a holiday watching our preparation and departure. We had to



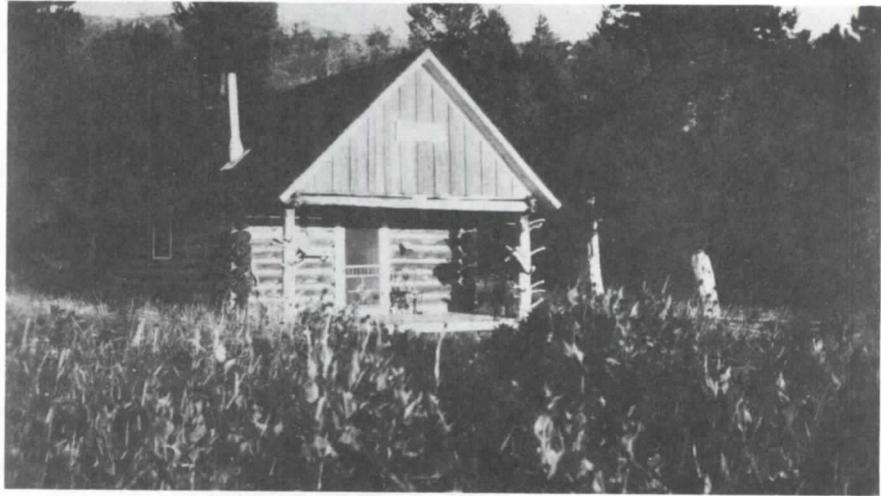
Sunday diversion—laundry hour, Minidoka National Forest, 1921.

climb about 3,000 feet and then drop down the same distance into a canyon for the first camp.

Equipment, supplies, etc., were more or less draped on the packhorses and had to be adjusted and rearranged every few hundred yards. To add to the pleasure of the occasion, the last part of the route was in deep snowbanks and monstrous windfall. Helm's remark on arrival at our camp site an hour after dark was memorable. He said: "I'll bet them horses will think after today that their name is '--- you!'" After the first 2 weeks, I worked alone (except for the packer) placing all station markers and then cutting them in by plane-table triangulation. There was nothing of note about the job except a lot of hard work, the scarcity of feed for horses, and the troubles of the packer finding them mornings in time for me to get a day's work done. I understand this situation is not greatly changed after 50 years, although it probably isn't in the best taste to say so. Much of the damage to range was done before there was a Forest Service, and some of it may never be changed for the better.

In 1923, I became the "other half" of the road engineer force, Oscar Torgerson being the other half. There were then 24 Forests in 5 States in Region 4, and we ranged over all of them, the general aim being to accomplish something with virtually nothing. The limitation (then) of \$5,000 per mile of road construction was wholly unnecessary—we spent on the average probably less than half that much.

An incident will illustrate the general situation. Evan ("Major") Kelley was at that time an inspector of roads activities to see that we got "more length and less width." Most roads were built to either a 10- or 12-foot width. The Major carried a yardstick with him, and when he found a road that exceeded standard by more than 3 inches—yes, *inches*—his wrath was something to be avoided.



Shoshone Ranger Station, Minidoka National Forest, Idaho, 1921.

Our job chiefly consisted of route reconnaissance and center line location of numerous projects done on the T.W. Norcross concept of "stage construction," which was an attempt to put the road on approximately what would eventually be a final location, but with widely undulating grade (which later could be improved). It worked, too! Many of these projects after 44 years are still on the same location but have been greatly improved by widening and easing the grades and even hard surfacing some of them.

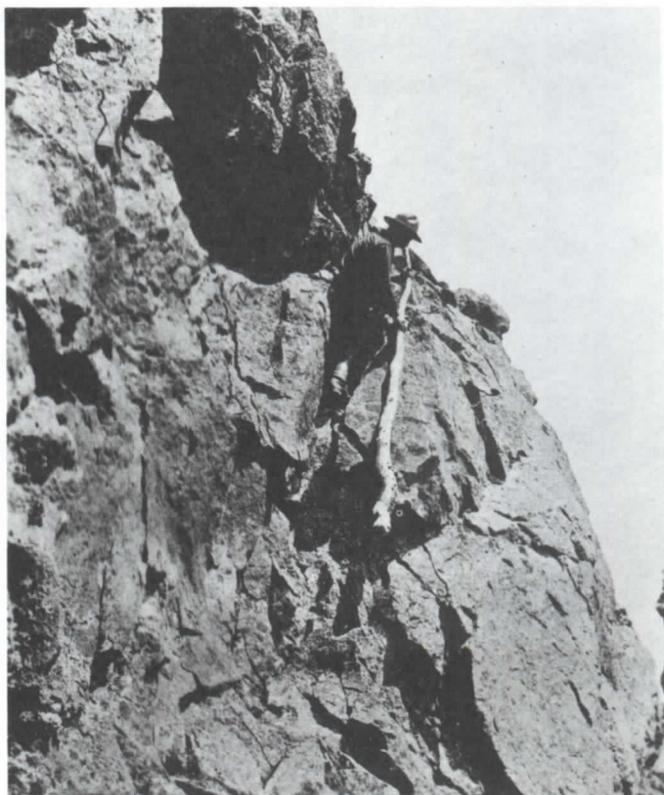
After 2 or 3 years, Torgerson transferred to the Madison Lab and stayed there until retirement.

Marshall Wright was transferred to Norcross's office in the winter of 1923-24, and I inherited his job. In the meantime, he had gotten a drainage (planimetric in 1967 jargon) survey under way of map deficient areas in Idaho (which was most of it). These maps initially were for fire control, and the standard, briefly stated, was "locate all culture and drainage within 1/4 mile of its true position." This probably was adequate then for that purpose but it became evident in short order that it was not adequate for many other purposes and requirements. So the standards were progressively tightened until, by 1930, when the program was about completed, the maps being produced came close to the accuracy and detail of the planimetric maps made during the past 10 years from aerial photographs.

A necessary part of this was establishment of control stations (latitude and longitude, and elevation). Three separate "schemes" of triangulation were done that virtually covered the forested area between the Snake and Salmon Rivers in Idaho, two "schemes" spanning southern Utah from the Henry Mountains to the Nevada State Line, and two covering the forest area in the head of the Green River in Wyoming. I personally did most of the triangulation and all of the calculations, and in some ways it was the most satisfying engineering work I have ever done, because it required precision—something not especially common to Forest Service work even now. It had



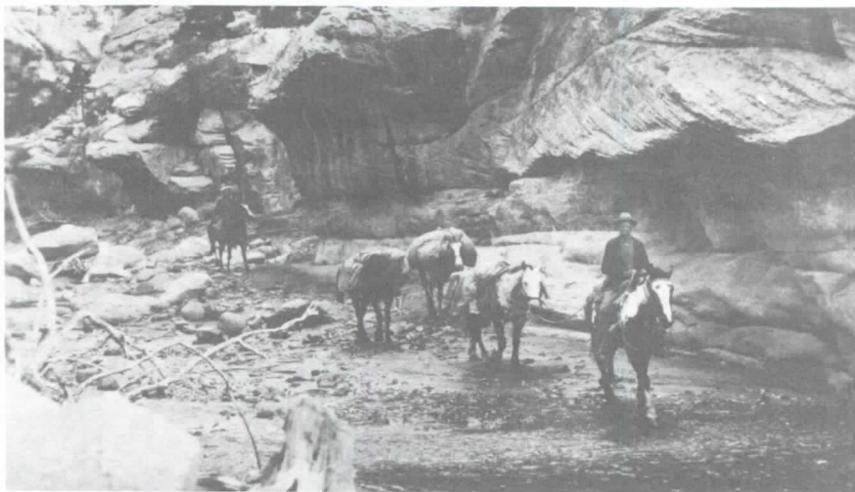
Pioneer Ranger Station, Fishlake National Forest, 1921.



Hauling signal pole to Triangulation Station, Fishlake National Forest, 1922.



*Timber survey crew, enroute between jobs, Snake River Plain, Idaho, 1921.
(Left to right: Dale Rustay, Don Romano, teamster, H.M. Shank.)*



*Charlie Truscott and triangulation party coming out of Henry Mountains,
Utah, 1927.*



Pack train on a dizzying point on Salmon River Trail, Salmon National Forest, 1924.



Cave Creek Pack Bridge on the Salmon River, 1924.

to be exactly right or it was "no go" and had to be done over. The physical difficulties were considerable (most stations were mountain peaks—some nearly 13,000 feet high), and the prospects of a repeat job were sufficient prod that no station ever had to be occupied a second time.

From 1923 to 1930, somewhat more than 10,000 square miles were mapped. Memory is tricky, but the cost was probably less than \$7.00 per square mile, exclusive of control.

Prior to 1921, there was no coordination between the General Land Office township surveys and control stations of the Geological and Coast and Geodetic Surveys. By 1930, nearly all forest maps were on correct latitude and longitude. During this 8-year period, minor surveys of every imaginable description were made in addition to the general mapping program. These included, just to mention a few, detailed topographic maps of special areas, surveys for water systems, bridge site surveys, a precision leveling job at Fishlake in connection with a squabble over water rights, and a survey of Lehman Cave in Nevada—interesting in that the entrance was nearly vertical and the projection of the meridian underground required some extraordinary doing and some of the passages were less than 4 feet high.

In those days, there was usually a commotion when a big fire occurred, and a lot of questions got asked as to why it was not discovered sooner. The answer often was that it was an area unseen by any lookout. I made the mistake of asking why we didn't find out what sort of "seen area coverage" we had and was promptly assigned the job and loaned to Operation for 1931 and 1932. It disclosed some glaring deficiencies as well as proving that visibility coverage could be mapped with acceptable accuracy in mountainous country, using only a planimetric map. Alas, lookouts are an anachronism—almost—in 1967, which could, one of these days, prove to be a mistake.

In the course of this work, I got caught up in the suppression of several large fires and in 1932, after the disastrous fire season of the year before, was assigned to make an IBM analysis of some 10,000 fires in Region 4. This led me further into the fire game and also into mathematical statistics. It is a matter of regret that events were moving so fast I never finished this job to my satisfaction. Among other things, I devised and put into operation in 1932 a system of measuring fire danger that worked and was used for several years in Region 4 until a better one was developed.

Ever hear of "cumulative humidity deficiency"? That was it. There are, till this day, others who swear by the method.

(If there is some dubiety at this point about this being an *engineering* chronicle, the only defense is that continuity must be maintained. After all, fire control is mainly a problem in logistics, which is certainly *engineering*.)

Also, there was an interlude in 1933 when I supervised the first nine State Civilian Conservation Corps Camps in Idaho and in 1934 when I organized some survey projects financed by the National Industrial Recovery Act. With these exceptions, from 1931 to 1936, I was on fire work entirely. A lot of this time was on the Payette (old Idaho) National Forest where there had been and still were a series of disastrous project fires due to a complete kill of the lodgepole stands by beetles in 1925–27; extraordinary fire weather

in 1931, 1934, and 1935; inaccessibility; rough topography; and deficient organization and equipment. This experience came in might handy when to my complete surprise, in early 1936, I was assigned to the Forest as Supervisor. My instructions were: "Get fires in hand or just keep on going North." It is a matter of pardonable pride that I didn't have to do the latter. The fire record of the old Idaho for the 4 years I was Supervisor is close to, if not actually, best of any consecutive 4 years in the Forest's history, despite 1939, which was a critical fire year.

The credit is due the personnel who needed only to be told: "Come on fellows, let's put 'em out," to the advent of the airplane, and to the Chief's new fire policy, which said in effect: "Control all fires in the first burning period if humanly possible, at whatever cost."

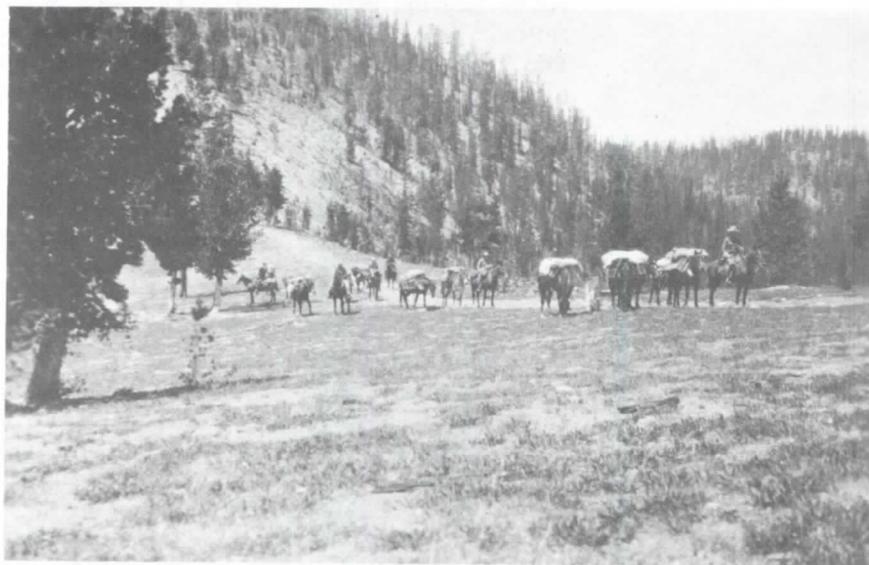
With Nick Mamer, one of the first pilots to do "fire" flying, we located, laid out, and constructed 14 landing strips, which still get a lot of use and which have played a major role in controlling potentially bad fires. The term "constructed" is used very loosely. None of these strips would rate as international airports. (There are said to be, even to this day, fingernail marks of Pat Thompson and Dave Godwin on the struts of a plane in which they flew by Soldier Bar strip, *without landing on it!*) So far as I am informed, however, there has never been a fatality in landing or taking off by any plane owned or under hire by the Forest Service, but this is more a compliment to the pilots than to the excellence of the landing strips.

(This thing has already gotten out of hand as to length.)

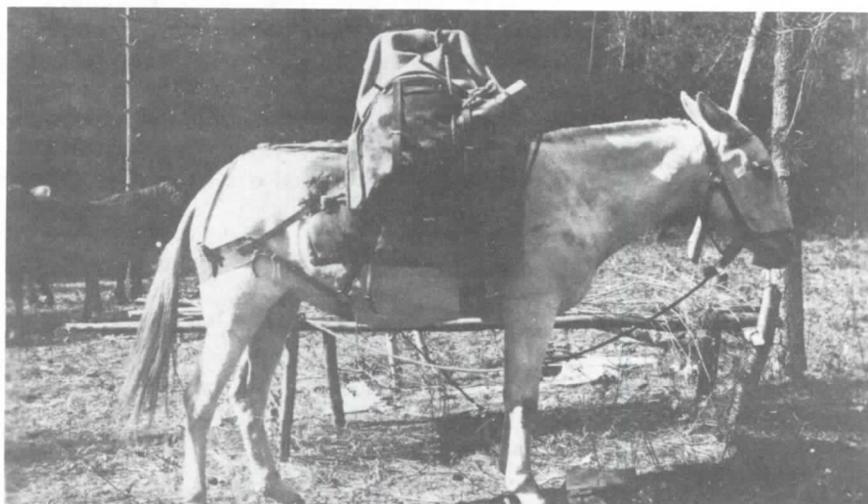
Early in 1941, I was made Chief of Fire Control in Region 4 and was so employed until early 1943, when I was made Regional Engineer, also in Region 4. The problems of those 4 years were those of a war economy in which both men and equipment were hard to get or keep. The Civilian Conservation Corps passed out of the picture, and Pacific Coast or other war industries absorbed all available manpower. Luck was with us in the first of these 2 years, which experienced unusually favorable weather conditions, and fire losses were nominal even though there was only a skeleton fire organization.

During the remainder of World War II, the Region managed to keep two "hot shot" construction crews and their equipment, which were used to construct timber and mineral access roads, one of which led to a mine producing at the time 60 percent of the world's supply of tungsten. Keeping this 100 miles of mountain road continuously open in winter with 7 feet of snow and temperatures as low as 60 degrees below zero required stouthearted men, but it was done.

Convincing Douglas-fir-oriented members of the War Production Board that there was *any* timber in Region 4 was a feat of psychology and persuasion. It resulted in construction of one \$450,000 project that produced nothing for the war but since has demonstrated its economic soundness. Many smaller projects also fitted this pattern.



Survey pack string rendezvous, Payette National Forest, 1922.



Faithful pack mule, Idaho National Forest, about 1925.

At the end of the War, Ernie DeSilvia and I were designated to make a 2-year study of the National Forest Trail System, during which we, together, rode horseback over 5,286 miles of trail and accumulated notable callouses not on the hands. A painstaking analysis, mile by mile, was made of what was needed. I recently reread the report after not having seen it for 15 years and concluded that not a word needed changing except to bring the estimates up to a 1967 construction cost index. It was used for at least 10 years by the Washington Office in apportioning road and trail funds to Regions, but whether it ever created a ripple anywhere else is doubtful.

During 1947-49, I was a traveling balloon for the Washington Office, sometimes trying to "sell" something in which I had no confidence but giving it all I had. Most of this was the most frustrating experience of my life because I seemed to be accomplishing so little that was constructive. It was the only time in my career that I felt I was not "paying my way." It did give me a chance to see the National Forests in all Regions in such detail as is permitted few others to do.

Minor affairs were collecting and coordinating cost estimates of the damage done by the great Columbia River Flood, another flood in West Virginia-Virginia, and still another in Tennessee-Georgia, which later proved to be "right on the button" and which resulted in the Regions getting funds for repair in days after they occurred.

I was made Regional Engineer, Region 2, January 1, 1950, and continued 10 years to retirement. Don Clark was Regional Forester for 8 of these years. Within broad limits, he let me do my job without interference. It was a satisfying experience. If anything of note was accomplished, it was in convincing Region 2 personnel that there was merit in constructing main stem timber access roads to a good standard, capable of being maintained at a reasonable cost. This frequently required some doing. Also, a program of planimetric mapping the Region was initiated and very nearly concluded in this 10-year period, clearly beating out any other Region except possibly Region 5 by several years. The Region thus had maps second to none, which have been absolutely essential to a timber inventory that was carried on simultaneously.

In the 39 years, 7 months, and 22 days I spent in the Forest Service, I was privileged to know personally every Chief from Colonel Greeley to Ed Cliff, and every Regional Forester; I visited every Region—most of them several times. With few exceptions, these men were "giants." I visited and spent some time on 108 National Forests; and spent most of nine winters in the Washington Office on a wide variety of details; at one time or another was in every State except Kentucky and Maine, so my personal horizons were wider than the average. If you are alive, curious, and have normal intelligence, you are a pretty poor specimen if you don't learn most of the things that are worth learning under such circumstances. For this I am profoundly grateful.

Not very many *people* have been mentioned, and they only in passing. This would be a fraud if I failed to mention a few of the people who have been outstandingly helpful to me over the years. They are (credited to the Region where I knew them): Region 1—Hank LaFaver, Rolf Jorgensen, Jim Ryan; Region 2—Marion Lamb, Matt Walker, Bill Nelson, Dan Roper;



*Transportation for boundary survey crew,
Toiyabe National Forest, 1925.*



*Shank and Bill Wood atop Mt. McGuire, Big
Horn Crags, Salmon National Forest, 1924.*



*Part of survey party coming out of Wyoming Mountains in October
snowstorm, 1928.*



Informal CCC conference, Brundage Mountain National Forest, Idaho, 1934. (Seated, left to right: Colonel Sampson, District Commander, Boise District; Dick Rutledge, Regional Forester, Region 4; Harry Shellworth, Southern Idaho Timber Protective Association; S.C. Scribner, Supervisor, Salmon National Forest. Standing, left to right: John Hargraves, Brundage Mountain Lookout; Nelson Brown, National CCC Inspector; Earl Loveridge, Assistant Chief of Operation, Washington; Roy Phillips, Supervisor, NezPerce National Forest; Dana Parkinson, Chief of PR (I&E), Region 4; Henry Shank, Fire Control Inspector, Region 4.)

Region 3—Horace Stephens; Region 4—Charlie Truscott, C.N. Woods, Verne Despain, Jack Kooch, George Nichols, Art Potter, Al Johnson; Region 5—Gerald Mitchell, Lloyd Rickel, Andy Brenneis, Kerm Lindstedt; Region 6—Hilmer Erickson, Don Cameron, Verne Church; Region 7—Webb Kennedy; Region 8—Rezin Pidgeon, Kelly Heffner; Region 9—Herb Hinsch, Kermit Udd; Washington Office—Earl Loveridge, Chris Granger, Peter Keplinger, Tony Dean, and Howard Jones. To literally hundreds of others too numerous to list, but to whom I am indebted, my thanks and smartest salute. It is a matter of deepest regret that at least seven of those named are no longer with us.

Autobiographical History of the Forest Service California Region—1923—1957

Charles L. Young

Autobiographical

Before Joining the Forest Service

As a brief autobiographical sketch, I was born in 1891 on a farm in western Yolo County, between the towns of Woodland and Madison. Shortly after my birth, my father gave up ranching but continued at his main occupation as a miller. In those days, most of the little towns had their own flour mill, where the local grain was processed. Most of my early life was spent in Woodland, the county seat of Yolo County, California. Here I graduated from high school in 1912. The next 4 years were spent at engineering work, largely with the Yolo Water and Power Company, which operated the local irrigation systems. In 1916, I entered the University of California at Berkeley, graduating in 1920 with a degree of B.S. in civil engineering with a major in irrigation. During the World War I period, I was in the Enlisted Engineers Reserve and assigned to the University for officers training. This was terminated by the Armistice. I worked my way through college by doing engineering work during vacations, my past connections standing me in good stead. I also had a scholarship my last 2 years.

After graduation, I spent the next 2 1/2 years working for several consulting engineers in San Francisco, being passed around as jobs developed. Between field assignments, they always found a drafting job in one of their offices to keep me available.

Employment by the Forest Service

While on one such intermittent employment in the office of Walter Huber (the brother of Ray Huber who spent many years as a Forest Service Engineer), I made my first contact with the Forest Service (circa 1923). Walter was a former District 5 District Engineer, now in private practice, and was then engaged in the engineering design of William Randolph Hearst's San Simeon mansion. One morning, a man in Forest Service uniform walked into the office, introduced himself as Fred Bowles, in charge of Roads and Trails for the California Region of the Forest Service, and wanted to know if I would go to Upper Lake in Lake County for a 2-week period and teach a new construction foreman, Wilbur Huestis, how to use grade stakes. This seemed like an interesting interlude, so, with Mr. Huber's consent, I took the assignment. This 2-week assignment ended with my retirement 34 years later.

When this assignment was completed, I was sent to the Eldorado National Forest to locate a road at Mosquito, near Placerville. I returned to my



Charles L. Young, 1948.

hometown of Woodland, picked up Ted Davidson, who had been my rodman on previous jobs, and proceeded to Placerville. This was Ted's initiation into the Forest Service. He recently retired, after spending many years on the Shasta-Trinity National Forests.

The next assignment was to Brockway, on the north shore of Lake Tahoe, where we located the Brockway-Incline Road. This was later extended around Lake Tahoe to the south shore. At this time, there being no roads connecting the two ends of the lake, we took a boat from the south to the north end.

While locating this road, we were amused by watching an elderly lady, who was owner of the Brockway Resort, doing her daily fishing in a little power boat. In those days, it was not proper for a nice lady to be seen smoking. Watching her through the transit, we observed that she used a very long cigarette holder. One day, we heard a commotion and saw her boat headed for shore under full power. She was standing up and discussing the situation in a very loud voice. The boat hit the shore, and she continued her journey for a considerable distance. We went to the rescue, but she was apparently unharmed.

This concluded the summer, so Ted and I went to the Regional Office for the winter. Our next problem was to secure Civil Service status, which was

not too difficult in those days. I took a transit man's examination to secure a high rating and started at a salary far lower than I had been getting before, but the Forest Service was in my blood, due largely to my association with Wilbur Huestis.

Road Surveys

Road surveys were rather primitive in the days when I entered the Forest Service. They consisted of a grade line run by Abney hand level and cut stakes. Cut and fill were kept to a minimum, the small radius of curvature used allowing the road to closely follow the topography. Although this sounds simple, it takes a better surveyor to make a free location, as it is called, than to make a paper projection.

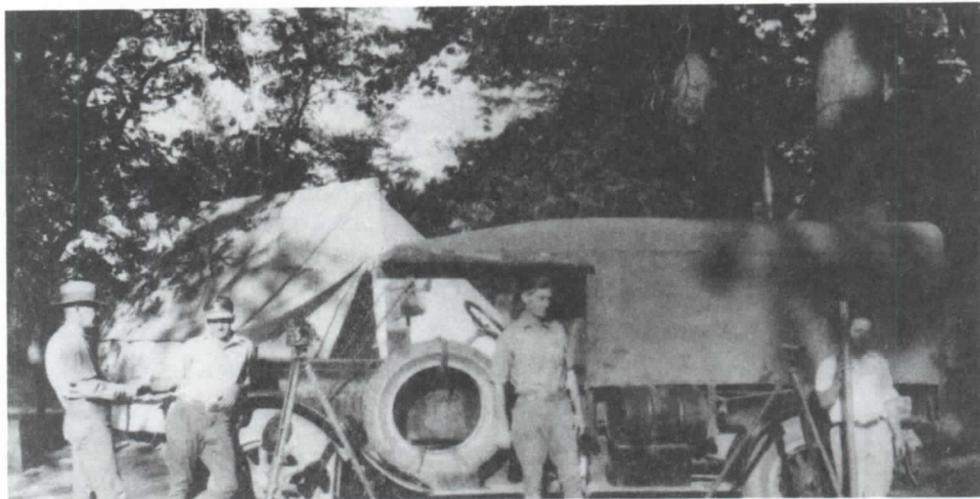
We traversed the surveys only when required by the necessity of obtaining rights-of-way over private lands. When this was required, we usually used the jump stadia method, with compass, by means of a transit. Only where we had magnetic interference did we make a traverse. Locating section corners was usually a problem. The old sectionizing surveys were usually very poorly made, especially when not on a township line. I found that it was usually easier to locate a corner by using a hand compass and pacing than by the use of a transit. This more nearly approached the method used by the early surveyors. When locating section corners in the Kosk Creek section of the Shasta Forest, I found that the township lines were quite accurately located but that the heavy brush that they traversed had been broken instead of cut, even including branches over an inch in diameter. Upon making inquiry of an old timer, I was informed that at the time of the survey, three miners had been killed by the Indians in this area. It appeared that a big Swede had done the clearing by hand to avoid the ring of the axe, so as not to attract the Indians. He must have been a powerful man.

Corners not on the township line apparently did not exist. Neither my party nor a Forest Service topographical party working this area at the same time could locate any. Again the old timer informed me that after the survey was completed, an Indian boy who had worked with the party was sporting a new rifle of which he was very proud. Shortly after that, and before the Government Inspector visited the area, a brush fire burned over a large area. It was peculiar that the rock monuments described in the notes were also consumed.

On another Forest, the Land Office notes described 2-inch by 2-inch oak stakes squared and scribed, as being at each corner. These should have been quite durable, but none could be found. I located an old Indian who had worked on the survey party when a lad and asked him if he knew where such stakes were. He said he could show me some. He took me down a trail and, pointing over the side, said, "There." I found a bundle of such stakes neatly scribed and tied by wire. On another occasion, I could not find a vital corner, so again found an Indian who had worked with the survey party. He assured me that he knew where the corner was, although it was many years ago that it had been placed. He took me to the locality of the corner, but no corner was visible. I inquired as to how the measurements had been made. The location was by a little creek at the foot of South Fork Mountain. He said that the Chief of Party said, "Well, that was pretty steep. We had better take off a couple of chains." We located a fir



Comparison of excavation on Angeles Crest Highway and Forest Service truck trail from Devils Canyon Saddle to Charleton Flats, Angeles National Forest, 1937.



Survey party with "White Elephant," 1925 (early survey truck rebuilt from World War I officer's White staff car).

tree that was described as a pine, from which the scribing had been chopped presumably by a resident to whom the corner was not favorable, and the 4-inch oak described in the notes was lying in the bottom of the creek, with its scribing still legible. Lead had been exchanged in an earlier day by the adjacent landowners over this line.

I spent my first 9 years in the Forest Service making road surveys in the summers. The winters were spent in the Regional Office working up survey data and on the A map and Progress Records. This included a road map of each Forest, showing the location of each road in a very diagrammatical manner and giving statistical data. These had to be revised each year, and ultimately included 20,000 miles of roads.

For our survey parties, our transportation consisted of a remodeled World War I Model T. After Chester Jordan took over the Roads and Trails Section, he secured a number of trucks from the War Department. They had been parked outdoors from 1918 until 1925. These he had rebuilt at Government Island, Oakland, by the Bureau of Public Roads' shops. The survey parties fell heir to two of them. They had been Army officers' staff cars and were heavy White trucks. The rear seats had been removed and replaced by a bed. A canvas covered the top, giving them the appearance of prairie schooners. These we dubbed our "White Elephants." They broke down upon every possible occasion. At this time, the Chief of Party got an honest-to-God pickup, so he was able to trace down the errant truck. Upon the advent of stakeside trucks, the Whites were replaced by Kleiber trucks. These were made in San Francisco and, aside from the fact that they had to be parked on a hill to get them started in the morning, were quite satisfactory transportation.

With the advent of more practical transportation, we were able to carry a larger crew, instead of picking up all but one assistant at each job. A cook was added so we no longer had to do our own cooking. We were covering the entire Region so had to shift from north to south quite frequently to keep ahead of construction. Construction crews at this time were handled by the Regional Office and assigned to particular jobs. They had no Forest control. Survey costs were not supposed to exceed \$100 per mile. The more difficult northern jobs often cost \$125, and the southern jobs in heavy brush country ran to \$300. The \$5,000 per mile limitation on construction did not include surveys.

The most important roads for whose location I was responsible include the following:

- | | |
|------------------|---|
| Angeles | Angeles Crest—from Mt. Wilson to Buckhorn via Red Box and Barley Flats. |
| Cleveland | Corona—Black Star Canyon from near Corona to near Orange. |
| Eldorado | Brockway—to incline on the north shore of Lake Tahoe.
Ralston Divide—from Mosquito northerly across the Rubicon River. |

Klamath	Elk Creek—from Happy Camp easterly to Hot Springs. Forest Boundary—from the Klamath River near Orleans, westerly to Cedar Camp. Bluff Creek—from Bluff Creek westerly to Serpentine Saddle.
Mendocino	Valentine Springs—Colyer Springs.
Modoc	Vicinity of Adin northerly.
San Bernardino	San Antonio—Lytle Creek, from Camp Baldy to Lytle Creek.
Shasta	Summit Lake—from Bartle Gap near McCloud to near Burney. Castle Lake.
Sierra	Dinkey Creek—from Dinkey Campground to Edison Road near Sawmill Flat. Chiquito—from Poison Springs to Jackass Meadows.
Stanislaus	Clavey River—from Quilty Mill to Corral Creek.
Trinity	Hayfork—Hyampom from Dinner Gulch to Hyampom. Hyampom—Willow Creek, from Hyampom to Grouse Creek with preliminary to State Highway near Willow Creek. South Fork Mountain—from Redding-Eureka Highway to Blake Mt. Wildwood—Hayfork Valley to Wildwood. Indian Valley—Redding-Eureka Highway to Indian Valley. Big Bar—from Big Bar southerly to Divide.

Ted Davidson, Marvin Shock, and Harlan Confer all handled parties under my supervision during this period.

When I started with the Forest Service in 1923, Ted Davidson, who had been one of my assistants in land survey work previous to this time, entered the Service with me. A few months later, Fred Bowles, in charge of roads and trails, traded Ted to Syd Stoner, who was in charge of topographical surveys, for Don Hoffman. Don was a graduate of a private engineering school in Oakland. Don ran an independent survey on roads and trails for a couple of years and then resigned to become an equipment salesman for the Edward Bacon Company of San Francisco. After Don's resignation, I handled all road survey work except that done by some Forest Supervisors in person.

Survey of the Hayfork-Hyampom Road

One of my earliest surveys was between Hayfork and Hyampom on the Trinity Forest. This was on the route of the pack trail from Eureka to Hayfork, which was the main supply artery of this section for many years. The advent of parcel post had changed this, goods coming to Hayfork from Weaverville by horse stage and later by automobile.

Trinity County had been working on this road for years, using a survey made by the Bureau of Public Roads and the funds allotted to Trinity County by the Forest Service in lieu of taxes. This had amounted to about \$5,000 per year. The Forest Service took over this operation in 1924, the County donating its share of the in-lieu funds.

When I first visited this project, I was accompanied by the Forest Supervisor, Hale Mace; the District Ranger, Harry Everest (a brother-in-law of Wilbur Huestis and a very capable Englishman); and my assistant Ted Davidson. We got into a Model T and started from Hayfork for the end of the road at Dinner Gulch. In these days, in addition to the narrow width of the road, there were no constructed turnouts. For years, whenever I staked a turnout (the specifications stated that they should be constructed at 500-foot intervals), there only resulted a hump in the road, since the minimum width was strictly adhered to. When we reached Dinner Gulch, the road ended, still 8 feet wide. There being no alternative, each one of us took one of Lizzie's wheels, and we turned her around. Such was life in the good old days.

On this project we hired locals. The county supervisor, a rancher in the Hayfork Valley, served as foreman. A considerable portion of the people residing in this area were descendants of the immigrants who originally had come from the hills of Kentucky and Tennessee, passed through the rich Sacramento Valley, and settled on the same type of mountain lands from which they had come. They had a few acres upon which they could grow their garden vegetables and corn; they milked a cow, shot their deer, and caught their fish. Their needs were small, and they ate well. Three or four months' work a year gave them sufficient money to buy their coffee, sugar, flour, and clothes. Why work more than that? Many of them had Indian or half-breed wives, so half- and quarter-breeds were common. There was no color line in this country, since practically everyone had brown-skinned cousins.

On the road construction jobs, when the deer season opened, we had to shut down operations for 2 or 3 days, since everybody went hunting. Why this was so we never could figure, since the natives did not consider that the game laws applied to them. They were for the city people. They used fish and venison for food. Their only practical method of preservation was by canning, so nothing was wasted and fresh meat was good. The wise game warden ignored them. The people were very hospitable. If you were near one of their homes around mealtime, you were always invited to eat. They usually made a few discreet inquiries as to your views on the game laws, and then brought out the venison. It was not polite to ask what kind of meat you were served. On one of his field trips, Harry Everest, the District Ranger, was served venison. He politely made no reference to this, but when his host came to town and boasted that the District Ranger had eaten venison at his home out of season, he had to take appropriate action.

One day when working on the road survey between Hayfork and Hyampom, which closely followed the trail, the most motley contingent that I had ever seen passed me. They were riding on horses, burros, and mules and in all types of dress. It appeared that a too ardent game warden in enforcing a recently passed game law that no salmon could be speared had descended on

the Hyampom Valley, and had arrested the natives in the midst of their annual salmon catch.

Since time immemorial, the people in this region had gathered on the rapids of the South Fork of the Trinity River and speared their salmon. This was preserved and served as a valuable addition to their food supply. All 75 of them were transported to Weaverville, the county seat. They demanded a jury trial, were acquitted, and were soon on their way home, where they continued their salmon pack.

Most of the families in this section were large. I was talking one day to the wife of the new Forest Service Ranger at Hyampom. She said that she could not hold up her head in this community. She only had six children. They mostly lived off the land. The storekeeper at Hyampom told me that the total expenses for a family with nine children for the previous year had been \$50.00. They bought coffee, sugar, overalls, and little else.

Trinity County, which covers a large area in northwestern California, had practically no roads when I first went there; therefore, a large portion of my time was spent in this area in my early days in the Forest Service. The entire population of the county was about 3,000 and the mining days were about over. The Forest Service supplied most of the cash income to the inhabitants. Firefighting was one such source of revenue.

Roads & Trails

At the time I entered the Forest Service and for many years later, Roads and Trails were in Operation under Bob Deering. Bob was Chief of Operation, which also included Fire Control and Personnel.

Fred Bowles left the Forest Service for a position with the Los Angeles County Sanitation District, and Chester Jordan, who had been Supervisor of the Santa Barbara, now Los Padres, Forest was given charge of Roads and Trails. From the resignation of Fred Bowles until Roads and Trails were taken over by Engineering in 1936, I was the only technical Engineer in this department. The going was pretty rough at times.

The first road construction in District 5 was started in 1920. I came into the picture in 1923. Construction methods were pretty primitive. Our tools were horses and mules, the single plow and the four up and six up plow, the slip-scraper (usually propelled by one horse), the Fresno Scraper (propelled by two horses), the Martin Ditcher (which was a triangular tool with two vertical sides, one of which was held against the cut bank, or initially a plow furrow and the other served as a cutting edge), and the horse-drawn road grader. Not to be overlooked was the man with the muckstick, or shovel, aided by a pick or mattock. He moved a considerable portion of the dirt, particularly in the tough situations. I have known a man to stand in one spot for as much as 2 days shoveling slide rock, where horses could not pass. Our first piece of power equipment was a World War I quad, or four-wheel drive truck, which was used to pull a road grader. Later, we used the Yuba tractor, a 15-horsepower unit manufactured at Yuba City in California and made for farm purposes. The construction unit usually consisted of 40 men. Clearing was done with the axe and crosscut saw, there being no power tools. The clearing crew was very expert in the use of the spring-board, a board notched into each side of a large tree. One man stood on

each board, and the saw was drawn back and forth in a swinging motion that was for the experts. Unless timber was needed for retaining walls of bridges, it was wasted down the slope. Trees were not to be cut if they could possibly be saved. We became expert in leaving trees in the berm of the road where they had to be removed later to allow the passage of vehicles, but that satisfied the inspectors. Where the country was real steep, many a tree went crashing down the slope. "The inspector will never find that," the foreman would say. Saving trees was a fetish with management. I have known of \$50 being spent to save two cedar trees that were later sold to a logger for \$2.50 each. Construction costs were limited to an expenditure of \$5,000 per mile. This required a lot of ingenuity in road location. I have tucked in many a mile of additional road, where it did not show, to go through easier country.

Roy Headley, who had been Chief of Operation in District 5 previous to Bob Deering, had taken a like position in Washington and, together with Major Evan Kelley, who was chief of Fire Control in Washington, held a stiff rein on affairs. Their concept of roads was pretty primitive, and this was reflected down the line. Allowable widths were 8 feet, with 9 feet permitted in exceptional cases. Minimum curvature was 25 feet with 35 feet as a maximum, gradient 7 percent due to the climbing ability of the Model T. Washington inspectors rigidly enforced these standards. On inspection they cut an 8-foot stick and if there was over 50 feet of greater width, you were informed that this excavation should be on the end and not on the side. Our boys soon found a remedy for this. When they heard that a Washington inspector was coming, they took a one-horse plow and reduced the width to 8 feet by turning a furrow. "That's all right," they would say, "we will get it back the next grading."

It is reported that Messrs. Headley and Kelley got into an argument on a road construction job as to which could move the most dirt in a day—a man with a wheelbarrow or a man with a one-horse slip-scraper. A fill was duly selected, and one such unit started at each end. Needless to say, the horse won.

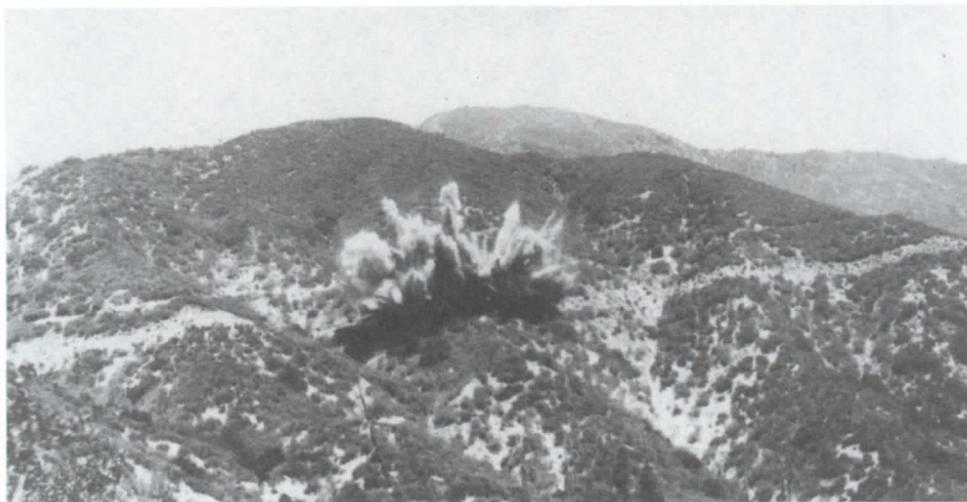
Road Construction

Equipment Development

During the period 1923 to 1935, road construction advanced from the hay-burner muckstick operation to a semimechanical status. The tractor and bulldozer came into the picture. The Best Brothers, located at Knights Landing in Yolo County, had been developing a farm tractor during my days in high school. They had a machine shop across the street from my home where their tractors were brought for overhaul and redesign. These early tractors had a single large cylinder with a large drive wheel on each side. The wheels stood about 6 feet high, and the tractors were really monsters. In order to get traction, they kept increasing the size of these wheels and the width of their tires. The tires were finally about 4 feet wide. At the same time, Holt in Stockton was working on a similar machine. His machine had to work in the Delta region where the water table was high and the ground very soft. To meet this need, he developed the track-laying principle, with very wide tracks. I understand that his early machines were 30 feet wide. Meanwhile, the Best Brothers had developed a multicylinder engine and lowered their center of gravity. They took up the idea of the



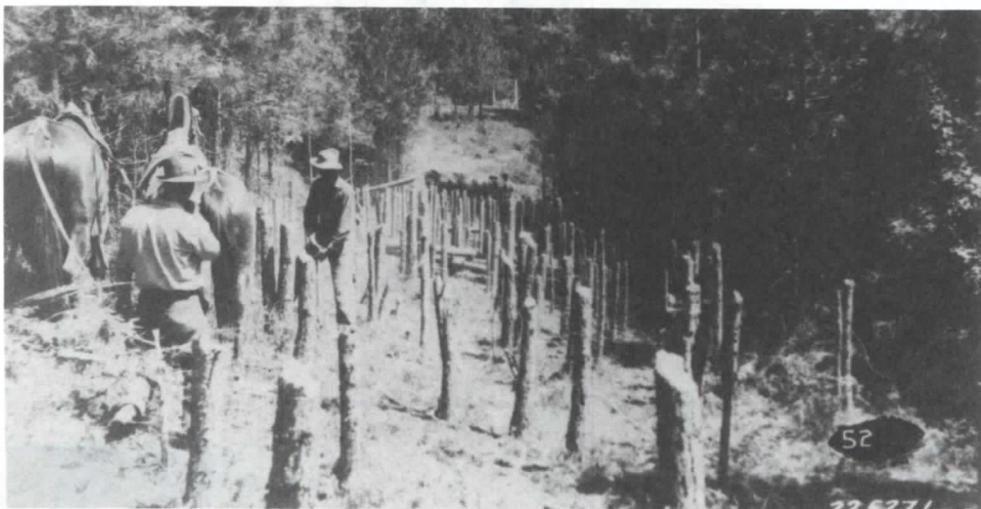
Snakeholing or coyoteing—preparing to blast on Mount Wilson-Chilao Road, Angeles National Forest, 1926.



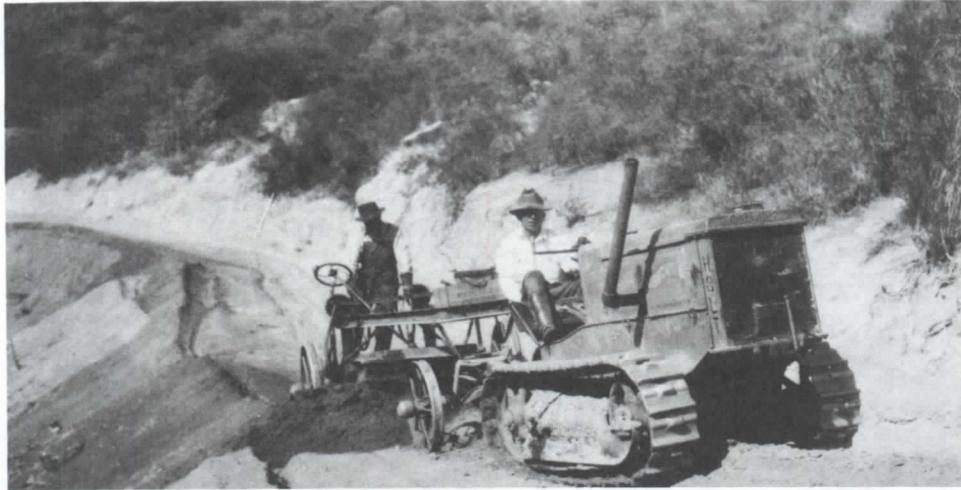
The shot, Mount Wilson-Chilao Road, Angeles National Forest, 1926.



*A primitive culvert consisting of a hollowed log,
Sierra National Forest, 1943.*



Stump rolling on Redwood Mountain Road, Sequoia National Forest, 1923.



Holt tracklayer pulling Russel grader with 6 12-foot blade, Corona-Black Star Canyon Road, Cleveland National Forest, 1927.

tracklayer and adapted it to their machine. This led to a lawsuit between the two interests. They compromised by uniting and forming the Caterpillar Tractor Company and setting up an engineering design office in San Leandro, near Oakland.

About 1927, Wilbur Huestis was given the assignment of developing a more efficient tool for road construction. Wilbur was very adept at model making, and began trying to fit something to the front of the farm tractor, then existing, instead of pulling plows and scrapers, as we were doing. He modeled a frame around the tractor, with a blade on front powered from the drawbar. Earl Hall, a mechanic with the Forest Service, and a former Cletrac salesman, was given the job of developing such a machine. Being familiar with the Cletrac, Earl started with the Cletrac 30-horsepower tractor

as his power source. For several years, he spent his winters at Government Island, Oakland, building these machines and his summers on the Forest in road building. After he had developed the principle, equipment manufacturers became interested, and the Forest Service dropped its development and began purchasing the machines.



30 Caterpillar tractor and Spears-Wells "Dinuba" ripper, Corona-Black Star Canyon Road, Cleveland National Forest, 1927.



Early Allis-Chalmers Motor Patrol, with tracklayer drive, owned by Siskiyou County, Klamath National Forest, 1930.



Martin ditcher (tool that followed plow furrow and made initial cut in road construction), 1921.



Road crew used in construction of Corona-Black Star Canyon Road, Cleveland National Forest, 1926.

While working on that project, Wilbur Huestis had decided that the surrounding frame was too cumbersome, so had consulted with the Caterpillar people on the possibility of redesigning their tractor so that the bulldozer blade could be swung from the sides of the tractor. They replied that since their business was in farm tractors, they could not afford to redesign as the construction market was not sufficiently large to justify such a machine.



Stock and equipment used in construction of Corona-Black Star Canyon Road, Cleveland National Forest, 1926.



Grader used in construction of Corona-Black Star Canyon Road, Cleveland National Forest, 1926.

Two years later, their representative visited us and stated that they were now designing such a machine and that they were 2 years too late.

The Davis Manufacturing Company at Davis, California, who were manufacturers of land-leveling machinery, became interested in the bulldozer, and we purchased a few of their machines. They soon dropped out of the picture. Shortly after this, La Tourneau, a highway construction contractor, located at Stockton, began building his antediluvian monsters, the first machines of welded plate design, and modern dirt moving was on its way.

It is interesting to note that this equipment development all originated in the Sacramento and San Joaquin Valleys in the vicinity of Sacramento, and all started with the need for more efficient farming equipment.

The early machines used cable lifts. A few manufacturers tried hydraulic control, but the hydraulic equipment at that time was poor and caused considerable trouble. In later years, hydraulic control was perfected and generally adopted, saving much wear and tear on the operators.

Fire Control Transportation Studies

In 1932, after 9 years of road surveys, I was transferred to Transportation Studies. Mr. Norcross, Chief Engineer in the Washington Office, Division of Engineering, set up the principles involved, and Wilbur Huestis was put in charge of the Region 5 work. Gordon Ingram and I were assigned as his assistants. The idea was to design a road system that would give coverage for fire control. Coverage was set up on the basis of time zones for three types of forest cover. The first Forests covered were the Plumas and the Sierra. "Bene" Benedict, who was Supervisor of the Sierra Forest for many years and an outstanding administrator, had developed the suppression crew. This consisted of motorized equipment and a crew trained in fire suppression. They operated under the supervision of Audie Wafford, one of the first fire control officers in the Region. The men on the crew were assigned jobs around Headquarters, in the warehouse, and in the yard and responded to fire calls. On a demonstration for our benefit, they reported to the dispatcher, with their equipment rolling in 70 seconds after the alarm was sounded. This was in contrast to the usual method, which involved considerable time lapse. I recall one incident when a fire call came into a Ranger Station that the District Ranger went and filled a canteen, gathered up his tools, cranked up his tin Lizzie, and took off, a mere matter of about 15 minutes.

The transportation study was based on the suppression crew and zones set up for 15-minute, 30-minute, and 1-hour coverage for the respective zones. Station sites were selected and a road system portrayed. In 1934, after the Civilian Conservation Corps program was under way, it was decided to extend the transportation study to the remaining forests. I was assigned the task of organizing this study. We made up two-man crews consisting of an engineer and a forester to log the roads on each Forest and prepare the necessary basic maps.

An office crew was organized to receive these data and do the detailed planning. At this stage, the control of the study was transferred to Fred Cronemiller and A.A. Brown, who conducted it until it was about 90 percent completed. Then it was returned to me for wrap-up.

The office quarters were in an old wooden engineering building on the University of California campus at Berkeley. We were assigned the upper floor, and Professor Lawrence, who was then beginning on the design of the atomic reactor, had the lower floor. At that time, Lawrence did not rate very high with the University management and operated largely with funds he obtained from outside sources. When he wanted to make a run with his reactor, he used to come upstairs and invite us to vacate our quarters. Needless to say, we readily complied and enjoyed our short recesses.

Civilian Conservation Corps Program

The Civilian Conservation Corps program was started in early 1933. At its organization, a committee consisting of Brevier Show, Regional Forester, Bob Deering, Chief of Operation, and Chester Jordan, Chief of Roads and Trails, held almost continuous sessions in the Regional Office, then in the Ferry Building, to get the program under way. They set up cots to get some occasional sleep and ate when they could. The Forest Supervisors were called in one by one and the camp setup and programs were worked out. There were no 5- or 10-year programs at that time so all had to start from scratch.

When the first proposals of the program reached us, I wrote a memorandum to Bob Deering, my superior, outlining the necessity for an engineering program, since the work would largely consist of construction and there was not an Engineer on any of the Forests. I proposed one Engineer for each camp, to be selected and given a preliminary training and orientation course by the Regional Office. Bob returned this memorandum to me with the comment that it was disapproved. I put S.B.S. (the Regional Forester's initials) on it and dropped it in the outgoing basket. About an hour later, I observed Mr. Show, with my memorandum in his hand, holding a discussion with Bob. A few minutes later Bob informed me that the survey program was mine. So started the most hectic 2 years of my life.

Paul P. Pitchelyn, who was in charge of Personnel under Bob Deering, was given charge of recruiting the Camp Superintendents, and I recruited the Engineers. The Regional Office was contained in one large room, which housed the entire personnel, about 75 at that time. The Regional Forester had a small room, and Doctor Meinicke, in charge of Entomology, had separate quarters. The rest of us tried to outshout each other to make ourselves heard. There were no official secrets. When the Forest Supervisors, each trying to get over his program, and Paul Pitchelyn's and my recruiting were added to this, it really was a madhouse.



First school for Civilian Conservation Corps engineers at Arroyo del Valle, Alameda County, Regional Office, 1933.



Engineers' housing, last school held at North Fork for Civilian Conservation Corps, Sierra National Forest, 1934.

Dr. Meinicke's rooms were on opposite sides of the hall that led to the rest rooms at the rear of the big room. He had a secretary who literally dove across that hall, with her head down, never looking. We really had to be alert to avoid collisions.

An initial survey school site was set up on private land at Arroyo del Valle, near Pleasanton, Alameda County. This site was selected so that it would be handy to the Regional Office at San Francisco, as I would have to divide my time while organization of the CCC program was under way. As assistants, I had Marvin Shock and Ted Davidson, who had been running survey

parties, and John West and Herbert Mueller, who were Civil Service roadmen. Fred Lorentz was installed as Camp Manager. John is now Chief of the Transportation Section of Engineering, our old Roads and Trails Section. There were no other Forest Service men who had road surveying experience.

Large numbers of high-class engineers were available, men who were laid off by the State of California, Los Angeles County, the power companies, contractors, etc. Even a former vice president of a railroad was available. In one day, I interviewed George Washington, Marc Anthony, and one man named Robert E. Perry. Upon remarking to him that I had a run of famous persons that day, he remarked, "Well, I have a right to that name." He was Admiral Perry's son. From these I selected the first school, and instruction started. John West had charge of the office instruction and Marve and Ted the field instruction. The pupils in the early schools were high-class Engineers. Instruction lasted 10 days and was largely on an orientation basis. Later, as the quality of the Engineers decreased and it became necessary to put out men with more training to match those in the field, instruction was increased to 30 days. The pay was munificent, \$125 per month (less 15 percent) from which board must be paid. Board at the CCC camps was very nominal.

As the school began to function, it became necessary to place the men in the field. This proved to be quite difficult at first. The Forest Supervisors had been used to operating with very sketchy staffs and doing so much of the work themselves that many of them could not see the necessity of more help. I would interview the supervisor and say, "John, how many surveyors can I furnish you?" John would say, "I will not need any. Jim can continue doing the road location." I would reply, "John, you are scheduled for five camps and Jim will not have time for any location work. He will be too busy helping you with the administration." After considerable discussion, John would finally reluctantly agree to accept one surveyor, largely as a favor to me. As the program progressed, the value of the Engineers became apparent, and later schools enrolled as many as 40 pupils. Our original staff, none of whom had college degrees, had a tough job facing the high-quality technical Engineers. They did a magnificent job and earned the respect of their pupils. The staff of the later and larger schools was supplemented by technical Engineers, as their experience developed.

Altogether, we held 15 survey schools. After leaving Arroyo del Valle, we held one school on the Sierra Forest at North Fork, two on the San Bernardino at Barton Flats to accommodate a group of Southern California Engineers, then moved to permanent quarters at North Fork.

Our school was set up as a camp as nearly like a CCC camp as possible, to get the men used to camp life before going to the various Forests. The men were divided into four-man parties for field work, and each party given a full-time instructor. Several parties were combined for office work, and lectures were given to the full crew each evening. Initially, the crews were made up on the basis of the data on their application blanks. The schedule was so arranged that at the end of 10 days, all parties were at the same point in their instruction. At that time, the parties were reshuffled and more nearly balanced for ability. On the average of all schools, one man in seven was dropped, many at the reshuffle period. Very few of the men assigned

field positions failed to make good. The biggest difficulty was alcohol, as they were all on their good behavior during the training period.

During the survey schools when I could break away for a few hours or a few days, I visited the CCC camps and inspected the work of the Engineers and road construction work. Much time was spent in the Regional Office on administration and in recruitment and placing of graduates of the schools. During this period, as well as the CCC program, we had the NIRA program, which consisted of construction fully financed by Washington. Camps of about 40 men were organized and equipped. Engineers were furnished. We were a bit slow getting this program under way, as men had to be hired, equipment purchased, and projects selected and surveys made. When we were getting nicely started, we got a letter from Washington saying that we had 25 percent of the NIRA money and only had 10 percent of the NIRA camps and that all of our money was withdrawn. This caused a shutdown of this program, which, however, was resumed at a later date.

We also had another project called ERA involving construction, which had a relatively short life. I also furnished Engineers to the State of California CCC camps, both State Forestry and State Parks. With the complications of these programs, I was busy hiring, training, transferring, and releasing Engineers, all at the same time. Among the Engineers hired during this period were a number who made the Forest Service their lifetime career. These included Donald MacBean, who retired recently after many years as Forest Engineer on the Sequoia; Giles McHenry, who served in the Regional Office in the Roads and Trails Section; George Newhall, now in the Regional Office of Engineering; Eugene Silva, head of the Equipment Development Center at Covina; and W.M. Minaker, who headed the Structures Section in the Regional Office for many years.

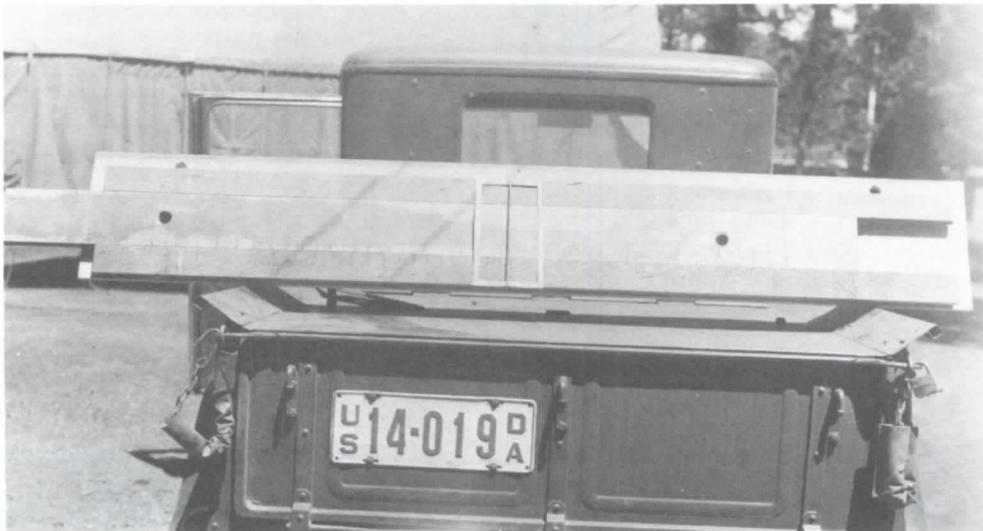
The Civilian Corps program was started in 1933, as a means of employing youths who were unable to secure employment due to the Depression. Camps of 200 men were organized for the purpose of doing work on the National and State Forests and the State Parks. This work consisted of road and structure construction, timber and grazing improvement, and like items. The camps were managed by the Army, who supplied overhead consisting of a captain, a lieutenant, and a sergeant. KP's and other personnel were taken from the enrollees. The work agency—Forest Service or State—supplied a camp superintendent and foremen to direct the work and the Engineers and other technical supervisors. The initial program included about 300 camps in California. The entire program was under the general supervision of the Forest Service, the State of California directing the work of their units.

Up to this time the Forest Service had been nonpolitical on the national basis. Now the Washington administration required that a certain percentage of the CCC appointees be made from a political list. Enrollments of the youths were for a 6-month period, which could be extended with the permission of the operating agency. As could be expected, many of the Army personnel assigned were not of the highest caliber. Most of the camp superintendents, while appointed by the Forest Service, had no previous Forest Service experience, although they were required to have had experience in construction and camp operation.



CCC personnel.

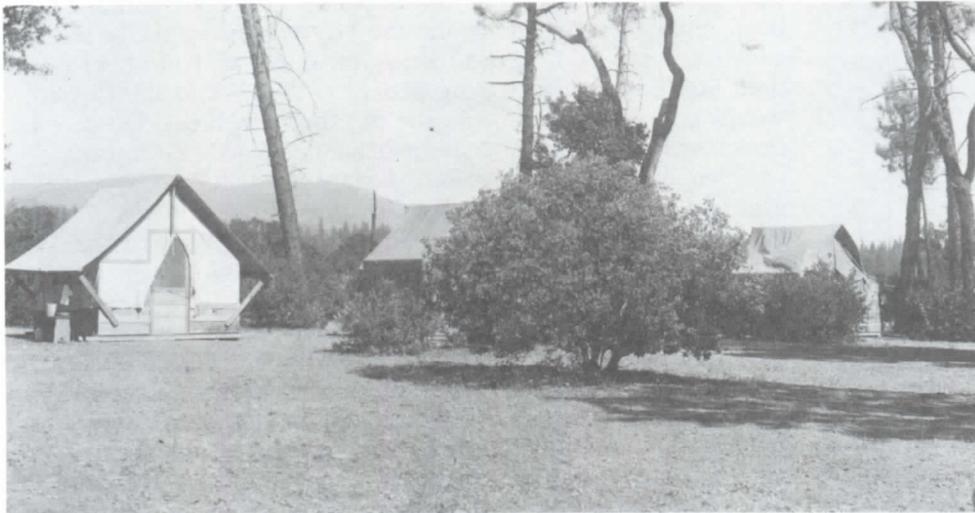
The Forests were totally unprepared for a program of this magnitude, there being no 5- or 10-year programs for future work. Up to this time, practically all survey and construction work had been directed by the Regional Office, and the Forest personnel had little experience. Programs had to be snatched from thin air. In spite of all of these difficulties, work proceeded. The first 6 months was pretty hectic. The Army concept of work as a punishment had to be reconciled with the Forest Service concept of the glory of work.



Slide rule used by engineers for instruction of Civilian Conservation Corps enrollees, 1934.



Mess hall and enrollees' quarters, Gravelly Valley Civilian Conservation Corps camp, Mendocino National Forest, 1933.



Officers' quarters.

The CCC enrollees from the country districts knew how to work, but the city boys had never worked, and many never intended to work. There was no guardhouse, so the Army was at a loss as to how to enforce discipline. They could fine the boys a dollar or dismiss them for flagrant violations. KP had to be carried on regardless, so could not be used too heavily as punishment.

With the beginning of the second enrollment period, things began to iron out. The best of the enrollees were retained and became the leaders. They could handle the boys much better than the adults could. Everybody knew his job, and administrative differences were reduced. As time went on, the

Army personnel improved, and many Forest Service men who had reserve officer status were put in charge of the camps.

Some camps had excellent personnel and enrollees, and all went well. Some camps with all city enrollees were difficult to handle. I visited one camp on the Klamath Forest manned from the Bronx. The camp superintendent said, "If you have anybody you want bumped off, we have men who will do it for \$1.50." Later, they escorted a number of their enrollees under armed guard back home. At another camp behind the beyond in the Stanislaus Forest, I asked the captain if he was not afraid to be so far from any help with his company of New Yorkers. "No," he said, "there is no one here capable of organizing a revolt. If there was, I might be able to do something with them." The camps were gradually reduced, until by 1939 they ceased to exist. Much work was accomplished by this program, and many boys were trained for future usefulness. I have met many in the days since then who pointed with pride to their CCC training.

On one camp on the Lassen Forest, the Army personnel had its problems. One CCC boy was being tried for misbehavior, before the captain, lieutenant, sergeant, and camp superintendent. As the trial proceeded, it became evident that the captain and lieutenant were not in the best possible condition. After a while, when the questions of the captain and lieutenant had been repeated many times and the boy was being badly confused, the camp superintendent said, "Boys, don't you think we had better postpone this trial until you boys get to feeling better?" "Yes," said the captain, "I think that would be a good idea." As the meeting was breaking up, a boy who was a troublemaker appeared. The lieutenant said to the sergeant, "Sergeant, that troublemaker is back in camp. I want my gun." It appeared that the sergeant was the custodian of the firearms of the officers. "No," said the sergeant, "You can't have it." Said the officer, "Who the hell is running this camp?" Said the sergeant, "When you and the captain are drunk, I am."

The Pine Valley Camp on the Cleveland Forest was noted for the fine work of the enrollees. They worked with little supervision except their own, and the Army and Forest Service personnel worked together nicely. As I was visiting it one evening, a new captain was introduced, replacing the former commander. As he addressed the assembled company, I was amazed by his speech. It appeared that the reason he had been assigned to the camp was because the personnel had not been treated right in the past. They had been worked too hard and had not been allowed enough recreation leave. He was here to see that their work load was reduced and that the hard-hearted Forest Service furnished more trucks to transport them to town on leave. Needless to say, the next day that was the most demoralized camp I ever saw. I understand that he was relieved shortly after. Such was life in the CCC camps.

The Ponderosa Way

The Ponderosa Way was conceived as a firebreak extending from near Bakersfield on the Sequoia Forest on the south to near Mount Shasta on the north, thence southerly on the west side of the Sacramento Valley through the Mendocino Forest. The San Joaquin and Sacramento Valleys would thus be rimmed by a firebreak, which would assist in preventing fires originating in the foothills from reaching the National Forests. It was to be in general

150 feet in width and to be cleared of all brush and all trees, which were to be pruned or removed.

I never knew who originated the idea, but it had the enthusiastic backing of Brevier Show, the Regional Forester. It was to be constructed largely with CCC labor. It was modeled largely on the firebreaks in use in southern California. Work was completed on several sections, and then it gradually dropped out of the picture and was heard of no more. On several sections, it worked in reverse. The removal of the vegetation allowed the growth of a grass cover. A fire would start up the firebreak, and to obtain control it was necessary to clear a line in the adjacent brush.

The Forest Service has largely discontinued the maintenance of its former system of firebreaks in southern California. Under Santa Ana wind conditions, they were of little or no value and, since the advent of the bulldozer, it has been possible to clear a line to mineral earth in advance of the fire, thus saving the annual maintenance of the firebreaks. This was largely a hand job. At one time, every major ridge in southern California had a firebreak. They were very visible from the valleys and were described by one early opponent as "The greatest system of outdoor advertising ever conceived by a Government agency."

In the early days, maintenance was usually done by a gang of laborers under the supervision of a fireguard. On visiting such a project one day, I observed that their hoes were very dull. On inquiring why they were not supplied a file to sharpen them, the fireguard replied, "If you give a laborer a hoe and a file, when night comes he will have neither, since he would



Ponderosa Way firebreak accompanying road, Sequoia National Forest.

rather sit in the shade of a bush and file his hoe than chop grass out in the sun.”

NIRA Cost Accounting

When the NIRA camps were organized, it was decided that since we had little information on the costs of road construction, costs should be kept in each camp. I was given the detail. A cost system was set up, and Engineers were hired and given a training course in our methods. As far as possible, men with previous cost experience were secured. These training schools were held in conjunction with the Location Engineers Schools at the North Fork site. Two schools were required since many of the men previously trained were not available, one at the initiation of the program and a second when the program was restarted after the shutdown referred to previously. I was assisted in this training by Fred Lorentz, who had served in the Interstate Commerce Commission. Inspectors checked the work in the field to ensure uniformity. From this work, the Regional Estimating Guide emerged.

Office Engineering

In 1934, Chester Jordan died, and Frank Jefferson was transferred to Region 5 and put in charge of the Roads and Trails Section. R.E. (Buck) Lane, who had been Forest Engineer on the Sierra, was made his assistant, and I was given the duties of Office Engineer. The Regional Office was moved to the Phelan Building, and I was given a suite of offices for my crew. This was a big relief after the Ferry Building.

My office crew consisted of five Engineers and two girls. We were engaged in handling the survey personnel on the Forests, completing the transportation study, assembling the NIRA cost study data, and inspecting the cost accountants in the field. We also supervised the work of two field inspectors on construction and one on equipment inspection. During this period, we wrote the Region 5 Truck Trail Handbook and the Drainage Manual.

I held this job for 2 1/2 years. During this time, the CCC program was reduced and the job load was much less. Buck Lane became familiar with Forest Service procedure and gradually took over more of the work. We were transferred from Operations to Engineering in 1936.

John Beebe, the Regional Engineer, set up John Lawrence as Assistant Regional Engineer, and he took over the Personnel work that I had been doing as well as other details. So I was given the job of starting the Arcadia Soil Laboratory, which later became the Materials Testing Laboratory and is presently known as Engineering Materials Investigations Branch, which I headed up until my retirement 20 years later.

Drainage & Truck Trail Handbooks

During my Forest Service career, the writing of the Region 5 Road and Drainage Handbooks was one of my assignments. My first experience was in 1934. Drainage was a crucial matter on road construction. It was usually conspicuous by its absence or its poor quality.

The Bureau of Public Roads set a very poor example on the projects that they built for us. Their desire to save culvert metal resulted in culverts that

only went part way through a fill or that were pointed to the nearest ridge, entirely out of the natural channel. The consequent erosion was very severe.

It was deemed imperative that we issue a Drainage Manual for the guidance of our construction men. The California Corrugated Culvert Company (Armco) had a very capable Engineer, Charles Colvin, assigned to our work. He worked with me, and we issued the first edition of the Region 5 Drainage Manual. This was distributed to the field, and the recommendations it covered were put into practice. Several special projects were set up to try out various recommendations. Our two inspectors of road construction, Colonel Gordon Fernald and Al Glendenning, were assigned special phases to promote. About 2 years later, the recommendations of various Forests were reviewed, the trial projects examined, and a new and much larger edition issued.

In 1939 to 1940, the old edition having become exhausted, extensive investigational work having been done on drainage on the Daley experimental project on the San Bernardino Forest (the first major assignment of the new Soils and Materials Testing Laboratory), and the results on drainage of the disastrous floods of 1938 having been thoroughly investigated, a new edition was issued. This was the final edition of my tenure.

In 1935, after Frank Jefferson assumed direction of the Roads and Trails Section, it was decided to issue a Handbook of Road Construction for Region 5. The Washington Road Handbook was better as a financial guide than a construction manual. Each of our Forests had been going its way, with the result that there was no uniformity. The Headley-Kelley influence was still predominant, with its doctrine of construction on the ends of the roads and not on the sides. Maintenance costs were excessive, due to poor construction and lack of drainage. Our road inspectors of the early CCC days each had his own ideas, and things were very chaotic. The bulldozer was just putting in its appearance, with the resultant increase of cut and fill and decrease of strictly contour alignments. We had just put two Engineers on construction inspection, Colonel Gordon Fernald and Al Glendenning, so the time was ripe for unification of design and construction.

I was assigned the job of Editor in Chief, ably assisted by Frank Jefferson, my boss. The field was consulted for ideas and for reviews, and we eventually got it written, and it was well received by the Forests. At that time, we were under Operations, just before being transferred to Engineering. We proudly sent a copy to Washington and were dismayed upon receiving an order from the Washington Office of Engineering to suppress the Handbook and have all copies destroyed. We had no authority to issue such a book, but could only issue supplements to the Washington Handbook. Needless to say, the Handbook disappeared from the desktops in the Supervisor's Offices, but could usually be found in a handy desk drawer. We always thought that Washington was a bit jealous.

In 1949, our supplement to the Road Handbook, being a bit out of date, was going to be revised. Mel Walker, Bud Fisher, Al Simpson, and myself were assigned the task of rewriting it. We assembled in the Regional Office and took on the task. After much work and several reviews by the Forests, the new edition finally appeared.

The Founding of the Materials Testing Laboratory

In 1937, I was given authorization to start a soils laboratory for the purpose of reducing the maintenance costs of Forests Service roads. John Beebe was Regional Engineer and initiated the project.

The bulldozer (called *trailbuilder* by the Forest Service) had come into general use. The roads of this period were constructed on contour with practically no through cut or fill. Dirt was overcast and usually the brush with it, with little advance clearing except for timber. Maintenance costs were excessive on the southern Forests, often exceeding 50 percent of the construction costs per year. Drainage was at a minimum or nonexistent. My first assignment was to devise construction and drainage methods to alleviate this condition. Frank Jefferson, in charge of the Roads and Trails Section, set up \$300 per mile as a permissible cost for reconstruction and drainage. A project was selected—the Daley truck trail on the San Bernardino Forest—as the experimental road. This road was built through a very sandy, decomposed granite formation that both washed and blew away. It also had numerous sections of excessive gradients.

For the 2 1/2 years preceding this, I had been Office Engineer for the Roads and Trails Section, so while I was making the transition and getting the new assignment organized, we set up a temporary laboratory on Center Street in Berkeley, in quarters occupied by the California Forest and Range Experiment Station. Here, I set two assistants working. This laboratory was over a restaurant. Compaction at that time was by the Proctor method, which consisted of pounding soil into a mold by brute force.

When the restaurant patrons complained of plaster in their soup, we were forced to move. We next set up shop in the laboratory of the Experiment Station at Tanbark Flats near San Dimas, in southern California. Our stay here was for about 1 month, after which we set up temporary quarters in a tent at Northshore Campground at Lake Arrowhead. Our project here was cement stabilization of the roads in the Northshore Campground. This was the first soil cement stabilization project west of the Mississippi River, and we wished to test its suitability for our roads. On the completion of this project, we moved the laboratory equipment to the Del Rosa warehouse, where we set up a temporary laboratory and started work on the Daley project.

We had considerable discussion as to the final location of the laboratory. Space had been reserved in a new Federal building to be constructed in the Civic Center in San Francisco, but when it was decided that the Forest Service was not to be housed there, other arrangements were necessary. Government Island in Oakland and a new equipment depot to be constructed in Stockton were considered. About this time, flood control work (now called erosion control) in southern California was being initiated, so considering that our laboratory would be active in this work, it was decided to locate in southern California. The Angeles Forest was constructing a fire warehouse and forest work center in Arcadia, so this site was selected.

The southern California fire warehouse had been started under the WPA program, but had not been completed. The foundations were in and the



Personnel of the Materials Testing Laboratory (left to right): Jack Fisher, Don Turner, Irving Sherman, and C.L. Young, 1955.



Left to right: Jim Marquis, Dan Ecker, C.L. Young, Fern Feldman, Leonard Stern, and Harold Meyers, 1955.

frame erected when we took over. We had to complete the building. This was finally done by means of CCC crews, road funds, and fire funds. Had it not been for a pile of "Mueller" lumber in the yard, this would have been impossible. Hap Mueller, General Foreman on the Angeles Forest, had accumulated a large stock of lumber secured by wrecking old buildings from many sources by CCC labor. This included doors and windows, so we were in luck. The laboratory was to have 1,000 square feet of space on the north

side of the building, and the southern California fire cache was to have the remainder. My estimate of the cost of the laboratory portion was \$1,700, so the "Powers That Be" cut it in half and gave me \$850. I did the electrical wiring and the plumbing myself, aided by one WPA man.

The funds for the building were allotted in \$500 units, so on Friday nights when funds were exhausted, we would tell our crew that they would be laid off at noon Saturday. Then about 10 a.m. Saturday we would get the next \$500. This led to very inefficient work. We finally got the building completed and moved in. We had been allotted \$3,000 for the purchase of equipment. Not having any place to put it, we had waited for the new laboratory before making the purchases. Imagine our consternation one day to receive a notification that our fund had been reduced to \$150 for the remainder of the year. The money had been withdrawn and given to the Sequoia Forest to put into improvements in the West Fork of the Kings River area. Ickes had decided that he wanted the area for the Park Service, and the Forest Service was desperately trying to save it. So Ickes got my \$3,000. After that, when I got an allotment, I spent it as soon as possible.

Financing the laboratory was extremely difficult. Frank Jefferson had been moved from Roads and Trails to Fire Control, and Buck Lane was now in full charge of Roads and Trails. To say that Buck's heart was not in the laboratory was to express it mildly. Buck, being an old logging man, figured that any money not going into the construction of logging roads was sheer waste. Besides that, Buck never was a hand for detail, and his great ambition was to get me back into the Regional Office to handle the detailed work of his department. For years it was a battle of wits, with the successive Regional Engineers giving me reasonable backing. However, Buck was able to divert a considerable portion of my time to other pursuits. As some of my assistants said, I got to spend time in the laboratory when Buck could not find something else for me to do. I supervised survey crews and construction jobs, inspected roads, made condition and maintenance surveys of roads and bridges, and did many other jobs in no way related to the laboratory. There was also considerable opposition to the laboratory by some of the old-line Forest Supervisors. As these were replaced by the new breed of college-trained men, my job became easier.

To finance the laboratory, for many years I was given \$1,000 per year to finance equipment purchases and operation outside of payroll. I used CCC boys as long as they were available and finally got financing for some personnel. Much of my payroll had to be financed by other sources. Funds being so limited, we had to construct most of our equipment with the assistance of mechanics from the Equipment Maintenance Section. Verl Jeffries, in charge of this section, was a real pal.

One of Buck's favorite procedures was to send me a telegram late in the afternoon, preferably about 4 p.m., requesting me to be in the Regional Office the next morning. When I would arrive there, it might be a Regional Office detail lasting a couple of weeks or a flood survey in northern California, and me without field clothes. My commitments, or the job I was working on, had to go by the board.

However, in spite of the difficulties, we made progress. As the old-line Forest Supervisors were replaced and as each Forest acquired a Forest

Engineer, the laboratory gained more and more support. Finally, about a year before I retired, work began coming in such volume that I devoted but little time to salesmanship. It was at last established and had found its niche. With the retirement of Buck Lane, succeeded by Clayton Seitz, I could at last devote all of my time to the laboratory.

Drainage Studies of Roads

In our early road construction, radii of curvature were low, and constructed widths were narrow. This allowed the road to closely follow the hillside, so a minimum of drainage was required. As the standards increased, fills became longer and higher and widths greater. This resulted in more roadway surface to drain.

In early CCC days, with the advent of the bulldozer (or trailbuilder as the Forest Service called it), a minimum of clearing was done. In brush areas, the brush was pushed over the side or into the fills, resulting in very unstable areas. (On the San Bernardino Forest, one fire burned so much brush from under the roadbed that the road became impassable.) All this resulted in annual maintenance of up to 50 percent of the original construction costs, in sandy soils.

During the CCC program, the design and proper use of surface, or open-top, drains were explored. Experimental projects were set up on several of the Forests, and wood boxes, railroad rails, and corrugated surface drains were tried out. Records were kept and photos taken. The corrugated surface drain was invented by an engineer with the California Corrugated Culvert Company named Sontag. He brought a sketch to my desk one day and asked my opinion of it. I was taken with the idea and suggested that he have some rolled out so we could give them a test. He did so, and we took them to the Sierra Forest and installed them. We tried them under traffic and took our biggest tractor of that time, a 30 horsepower, and tried to rough them up. They successfully withstood all tests. We placed an order on 12 carloads. The company had difficulty rolling them and had to build a special machine for the purpose. We had specified a particularly high-carbon content in the steel to make them stiff. They found it impossible to roll them with this steel, due to the excessive breakage, and had to reduce the carbon. By this time, quite a few months had elapsed, and the 60-horsepower Caterpillar tractor had come into general use. Every time a big tractor ran over one of these surface drains, both ends curled up into the air. We found them very useful in building latrines and as guardrails. Today you will see miles of them, slightly modified, used as guardrails on the major highways.

Outsloping had always been used to get water off the roadbed. This worked successfully on clay-type soils but was plain disaster on the sandy granitic soils of southern California. Our major road-building agencies had used culverts in cross drains that were too short and often stuck out of the fills, perhaps 5 feet or more above the streambed, causing large damage by erosion. They also often ran gulch water down the road to a second crossing to save pipe. Common practice was to carry water on the roadbed and outlet it on an outpoint, where it caused excessive damage on the developed soil.



Railroad rail surface drain, 1938.



Corrugated metal surface drain, 1938.

Berms were coming into common use on the State highways, but found little acceptance in the Forest Service. With the founding of Arcadia Soil Laboratory, one of the first assigned projects was to work out methods of drainage control for our Forest roads. In 1937, an experimental project was set up on the San Bernardino Forest, a temporary laboratory and manpower and equipment were assembled, and the Daley project was under way. This consisted of a 2 1/2-mile section of truck trail having some steep grades and very sandy, decomposed granite soil. The area was subject to heavy Santa Ana winds. On this project the objective was to control the water until it was safely deposited in natural channels. Berms were used, together with intercepting dips, surface drains, and cross dips, as well as culverts. Long downspouts were used as required to take this water to natural channels. Ideas were solicited from the Forests and tried out. After the project was working satisfactorily, Engineers from the Forests were brought in for review and criticism of the work. Berms were built of generous size since the heavy winds blew much of the material away. One Engineer's criticism was, "Ah, the great Daley Canal." The best features were included in the next revision of the Drainage Handbook.



Corrugated metal and railroad rail surface drains, 1938.



Completed apron showing underroad construction and berm, 1941.



Mueller dip apron, 1938.



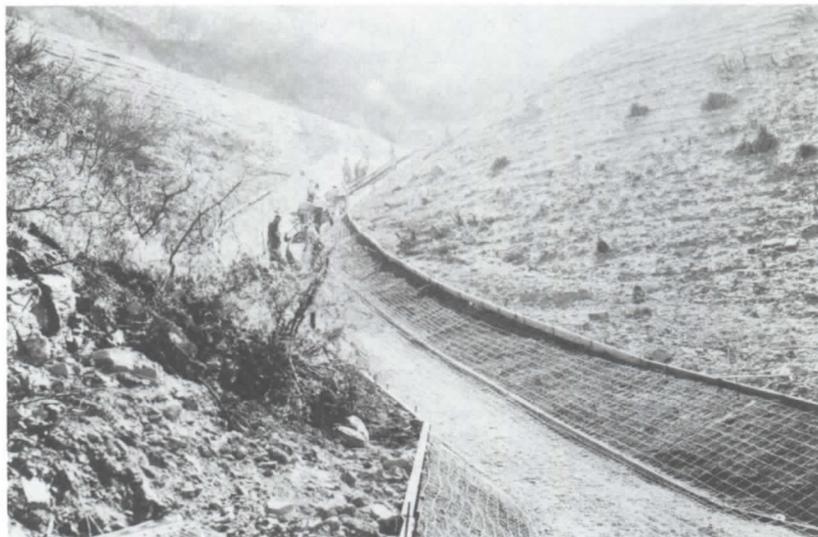
Closed pipe dip apron, 1938.

In 1939, large spillway aprons were built on the Cloudland and Strawberry Truck Trails on the San Bernardino Forest. In these installations, the water was taken over the road and down the fill banks to safe location in the natural channel. They often included retaining walls to increase the stability. In 1941, the Applewhite and Lytle Creek Divide Roads were reconstructed with WPA and flood funds, and a number of these spillways were built. Asphaltic concrete, asphaltic macadam, and soil cement were used.

As a result of these studies and work done on several of the Forests, the concept was developed of containing the water completely and depositing it



Apron crossing road, 1941.



Flume section under construction, 1941.

safely in natural channels. This often requires the use of long flumes but that has now been accepted.

Several types of spillway aprons made of metal were developed and are now in use. These include the Mueller and the Berkeley aprons, and modifications. Soil cement, asphalt, and concrete are also used in the construction of spillways. In clay-type soils, where erosion is at a minimum, outsloping is allowed.

As of the present date, 1968, many miles of our roads still lack complete drainage control, but advances are being made as funds allow.

Erosion Control on Fill Slopes

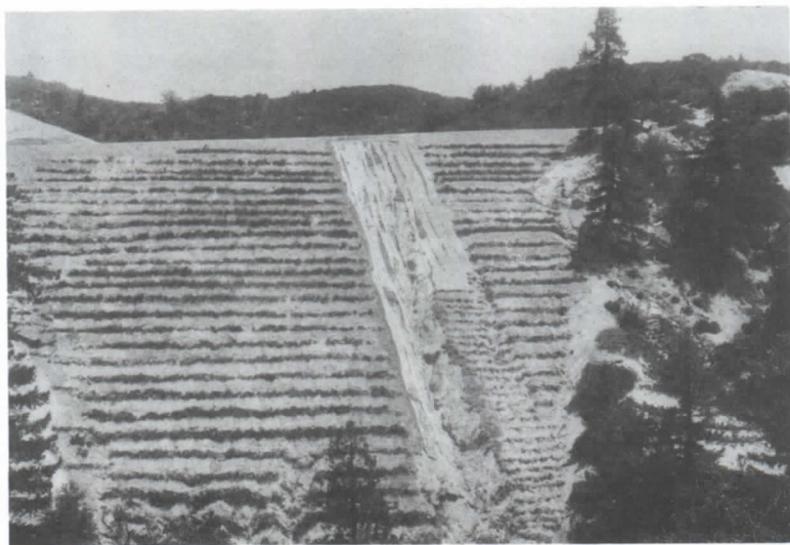
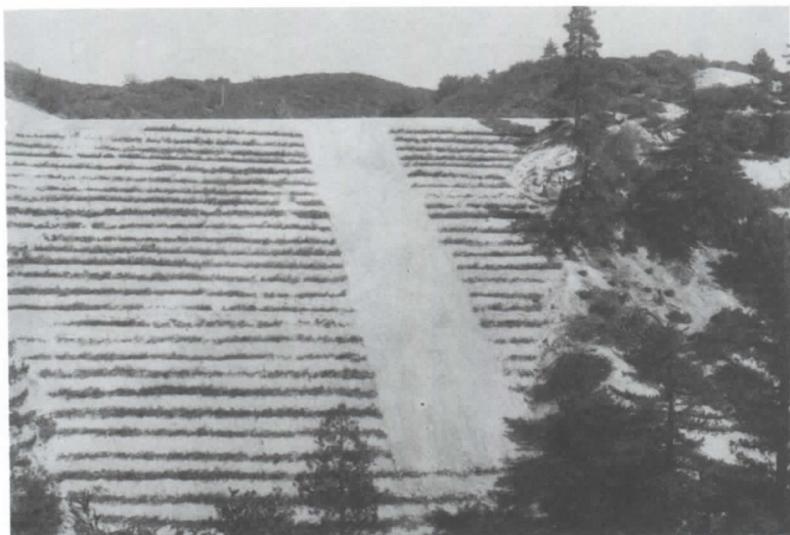
In order for a road to be stable, not only must all cross drainage and surface drainage be cared for, but the cut banks in erosive material and all fill banks not consisting of rubble must be stabilized. The first consideration in fill bank stabilizing is to provide a bond to the original ground surface and a slope not in excess of the angle of stability of the overcast material. This is best secured by making a bulldozer cut at the base of the slope and compacting the added material as the fill is built up. This is not always practicable, particularly in thin section fills, in which case the stabilizing problems are increased.

Numerous methods have been used in fill stabilization, the best using contours of some sort: wire matting placed in the file horizontally as the fill was built up, staking and brush wattles, grass planted in contours, wire matting covering the slope, netting of various sorts, pine needles with and without staking, straw punched in, forest litter—you name it. All of these methods are valuable, but for ultimate results the fills must be covered with vegetative growth. Sometimes this can be secured from the forest litter added, but usually planting must be made.

In this revegetation, the plants used must be those that will prosper in that particular location. These may be natives or exotics. They may require watering and care for a period, or they may be able to make it on their own. The soil making up the fill is very important in this regard. If it is a raw mineral earth, survival may be difficult. If it is of sedimentary origin, survival may be good. Usually it is necessary to use some type of vegetation that will make a quick growth and ultimately be replaced by permanent plants. Ryegrass and Baccharis have been freely used for this purpose.

Much investigation and research have been done. The State of California, the Forest Service, several counties, and several contractors have been interested. The Forest Service Experiment Station at San Dimas has been working on stabilization for years. Gus Jurhens, Silviculturist with the Los Angeles River Erosion Control Project for many years, not only was very active with this work, but he interested Dr. Fritz Went of the California Institute of Technology. Much research in plant growth under the climactical conditions existing in our areas was done in their Phytotron, or controlled climate, laboratory. Our Arcadia Soils Laboratory worked for a number of years on soil analysis, folial analysis, moisture determinations, and other phases of this study, and assisted Gus Jurhens in setting up field study sites or road fills, as well as other areas. The State and County Arboretum at Arcadia is working on finding plants that are fire resistant for use in southern California areas and now has several plants available.

The big problem is to restore a plant cover; otherwise, erosion will result. To restore a plant cover, not only is it necessary to provide the plants, but they must be given a reasonably stable place to grow until their root systems can take over.



Angeles Crest Highway Station 1361+79 wattle slope with cloth placed on vertical section for comparison, Angeles National Forest. This page: November 1937 (top) and June 1938 (bottom). Next page: April 1945 (top) and October 1948 (bottom).





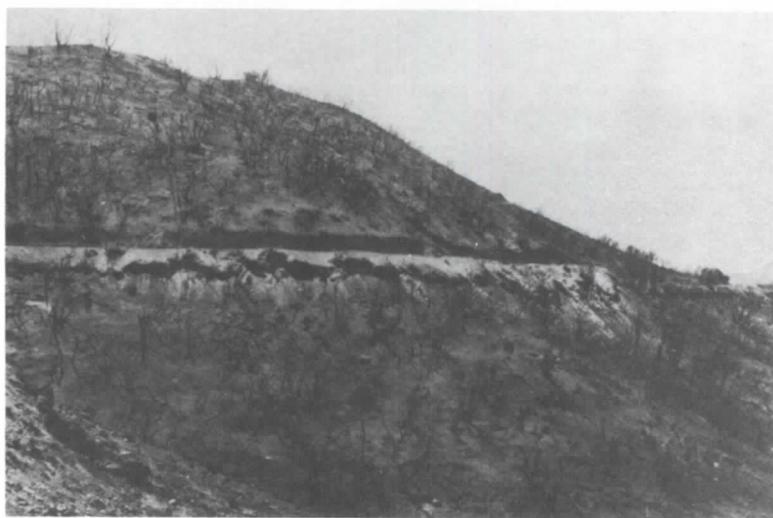
*Day Canyon Truck Trail erosion, Angeles National Forest, 1938
(erosion on fill slope by rain only—no water passed berm).*



*Fill erosion near San Joaquin's Bridge, Italian Bar Truck Trail, Sierra
National Forest, 1938.*



Brush and needle protection on fill slope, Chiquito-Daulton Truck Trail, Sierra National Forest, 1938.



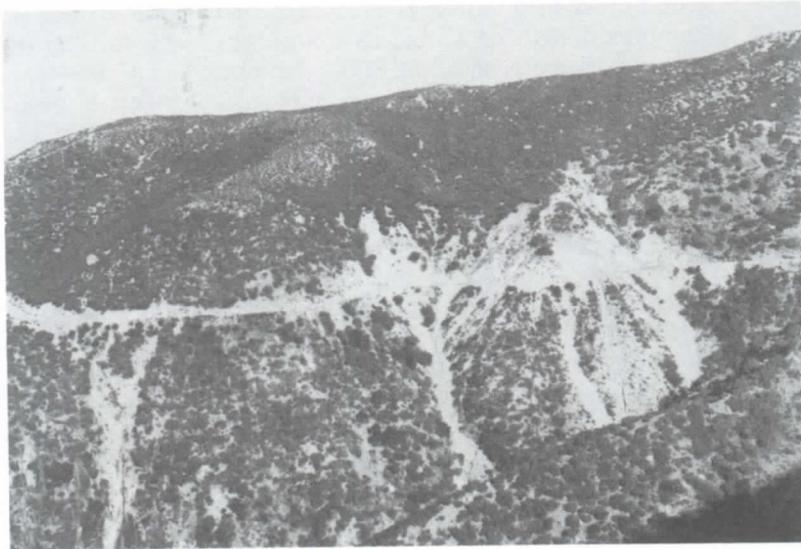
Brush burned under from fill, Lytle Creek Divide Truck Trail, fire of 1940, San Bernardino National Forest.



Drainage and fill slope stabilization, San Bernardino National Forest, 1941. Top: Before treatment. Bottom: After construction of inter-coupling dip, downspout, and wattling.



*Fill slope stabilization, San Bernardino National Forest, 1941.
Top: Before treatment. Bottom: After filling and wadding.*



Erosion fingers caused by overcasting, San Bernardino National Forest, 1945.



Effect of litter treatment in preventing erosion on cut slope at Station 589+75, Mammoth Road, Sierra National Forest, 1955.

Road Maintenance Studies—Condition Surveys

In 1940, Tony Dean, our Regional Engineer, decided to make studies of the conditions and maintenance of the Forest Service road system. Tony and Ray Huber, then in charge of Structural Design in the Regional Office, made a trip to the Mendocino Forest and tried to set up a system. They did not come up with a workable answer, largely because they considered the complete length of a road as a unit. In 1941, the job was then turned over to me. I secured Marvin Shock as an assistant, and we started on the Trinity Forest, where we were assisted by Albert Simpson, the Forest Engineer. We set up the subdivisions to be considered and using one-tenth of a mile as a unit came up with a workable system.

After the completion of the Trinity study, work was continued on the Klamath, Shasta, and Plumas Forests. In 1942, we made a study of the Sierra Forest, then returned to the Trinity and, based on the condition survey, made a study of the proper maintenance costs, again assisted by Mr. Simpson. In 1943, Marvin Shock took over and did the Eldorado and Los Padres Forests. In 1944, he and I got together and revamped the system, making a number of revisions. In 1945, Gerald Mitchell succeeded Shock and continued with a study. After giving Mitchell a hand in getting started, I dropped out of the picture.

The study gave a pretty good picture of the present condition of the roads on the various Forests and a striking comparison of the differences in maintenance on the various Forests. It was interesting to note that where the maintenance was handled by a nontechnical man, it was usually better than where handled by the Forest Engineer. Tom Bigelow, General Foreman on the Klamath Forest, had the best-maintained system.

Flood Damage Surveys

After every major storm doing damage to our roads anywhere in the Region, I was usually given the assignment of making a flood damage survey. Reports were made of these surveys, with photographs, and submitted to the Regional Office. This often includes bridges.

After the floods of 1938, I spent 2 months going over the roads on the four southern California Forests and collecting data, which resulted in revision of the Drainage Handbook.

I usually took a pickup, and someone from the Forest visited, for the trips. On most of the roads, we were the first to traverse the route, so we met with many difficulties and adventures. I remember one road on the San Bernardino Forest. We set out from a CCC camp early in the morning and in late afternoon had reached a stream beyond which the State highway was visible. But the stream was running high and the crossing was full of big boulders. After a council of war, we decided not to risk a crossing, so we set out to retrace our steps. It was late that night when we returned to the camp. On another trip, I had two companions. We got stuck in a stream crossing, as usual (I used to claim that I had been stuck in every stream in southern California), and our jack broke. We were helpless, and had to start hiking for the nearest camp, which was at Lytle Creek on the San Bernardino Forest. We were on the north side of the Lytle Creek divide, and the camp was on the south side, about 10 miles away, with a road connecting. However, every gulch crossing in that whole 10 miles was completely



Loss of Camp Baldy Road below Ice House Canyon, Angeles National Forest, 1938.



Loss of multiplate arch culvert at Bouquet Canyon Highway, Angeles National Forest, 1938.



Loss of twin 24-inch culverts, Lockwood-Sespe Truck Trail, Upper Sespe Creek, Los Padres National Forest, 1938.



Loss of multiplate arch culvert, Lockwood-Sespe Truck Trail, Los Padres National Forest, 1938.



*Fill washed out, Plunge Creek Truck Trail,
San Bernadino National Forest, 1938.*



*Loss of road above old F.R.D. Camp, Cachuna Truck Trail, Los Padres
National Forest, 1938.*



Former site of Bonita Public Camp, Lytle Creek, San Bernardino National Forest, 1938.

washed out, so the going was really rough. We reached camp about 9:30 p.m. That was the only time I ever walked away from my car.

The Lost Padres Forest had installed a large number of multiplate arch culverts in their main stream crossings. These crossings were usually on alluvial fans. The culverts were placed on adequate concrete bases on the fan material. With the increased depth of water, the alluvial material became unstable and the bases were undermined, resulting in the loss of the culvert.

On the Angeles Forest, the San Gabriel Mountains rise at a very steep angle from the plains to the south. The storm of 1938 hit this range from the south and was forced upward. At the summit, it met the air from the desert to the north and unloaded immediately, with the result that the roads on the south side were severely damaged, while 100 feet north of the saddles the roads were untouched.

Often I had to submit cost estimates for rehabilitation. This was particularly true of the logging roads constructed by the Bureau of Public Roads. Due to their construction methods and deficient drainage, the first winter's damage was often severe, with loss of road surface and fills.

However, Flood Damage Surveys were very interesting, if often strenuous, and a good break from routine. They helped to develop leg muscles, improve your driving ability, and learn all possible ways of unsticking the stuck cars.



Cone deposited over State highway and Santa Fe Railroad (tracks by 1938 storm), Cajon Canyon, San Bernardino National Forest, 1938.

The Guayule Program

In the latter part of October 1942, I first made contact with the Guayule Program. At that time, I was engaged in paving the Stockton and Redding Equipment Depot yard. Woodland, my old home town where I was raised, is located between the two on the Southern Pacific Railroad. Due to the war, we could travel by auto only where other transportation was not available. Space on trains was also in short supply. I found that wearing my uniform was a big help, and that by going into the men's room I could usually find a place to sit, although men sitting on their suitcases in the aisles were quite common. The regular trains were sidetracked for troop trains, so traveling was quite tedious.

The superintendent of the Woodland area heard of me through some of my friends in that locality. I had received most of my grammar school and all of my high school education in Woodland, had spent 4 years between high school and college working for the Yolo Water and Power Company, the local irrigation company, at irrigation engineer, and had worked after college with a local irrigation engineer at farm development, so I was very familiar with the farms of the surrounding countryside.

I received a request through the Regional Office to stop off at Woodland when passing through and contact the local Guayule organization. Mr. R. Lewis, who was with the Irrigation Department of the Oregon College of Agriculture, was in charge of irrigation for the entire Guayule Program, under Henry F. Blaney. He met me and went over several of the leases together. Later, Mr. Pomeroy, who was in charge of leasing, took me over the projects. On the 3rd of November, we held a conference with the local organization and with several of the overhead from headquarters at Salinas, where present and future plans were made. Land survey crews were assigned, and the work was under way. By the end of November, I had the paving jobs about completed, so I could devote my full time to Guayule. I was assigned land leveling and preparation for irrigation, after which the planting crews took over.

Being familiar with most of the leases, I had Headquarters give me the leveling and irrigation requirements for Guayule culture and started the land leveling operations. Most of the Sacramento Valley in that vicinity has a

slope of about 5 feet to the mile, which is very flat for irrigation and often required considerable movement of soil to develop enough gradient to move the irrigation water. Also, the land was often potholed, so careful and expensive work was required to eliminate pools.

When the Guayule program was set up, its administration was assigned to the Forest Service. Many of the personnel were transferred from the Shelterbelt project. Others were recruited from the various Regions. The greatest difficulty I had with those responsible for the administration of the project was to get a decision out of them. They just could not be pinned down. Also, most of the personnel were Forest-trained and had but a small knowledge of agricultural methods. After several conferences with those responsible for the land preparation and planting programs, I decided that since I was on detail and could only be sent back, I would proceed as I thought best. I was severely criticized at times, but at least the work advanced.

Rental of around \$20 per acre per year was paid for the use of the land. Being wartime, and agricultural products being in great demand, the land leased was usually deficient in some aspects. It got to be a standing joke, when the leasing section reported a new acquisition, to ask, "What is wrong with it?" There always was something wrong. It finally got so bad that an order was passed that the Land Preparation Section should be consulted before a lease was signed. On one lease in southern California, the land was perfectly leveled and in alfalfa. All that had to be done before planting was to remove fences and knock down the checks. When planting was held up pending a decision as to the continuation of the Guayule project, the owner required that we irrigate his alfalfa to keep it from dying. We then learned the reason for the lease. Every time we turned the water into a concrete pipeline, it blew out. It was made of the old type of handmade concrete pipe, and had reached the end of its life. Repairs kept a crew busy until we finally released the land.

One of the requirements of management was that the planting machines be kept running. They were always on my tail. I would put in a 3-foot fill one day and find it planted the next. The rains would hold up the heavy land leveling equipment for several days but not the planters. They were out with the sun. It was quite hectic. The land in the Woodland area was largely Yolo clay loam, which was a heavy soil that was hard when dry, so it had to be irrigated in the fall before it could be worked. But after the start of the winter rains, usually in early December, no equipment could be used on it until it dried out in the spring, usually late April or May. To be able to get on the land earlier, the farmers would plow in the fall and leave the land with deep furrows. The north winds in early spring would then dry out the ridges, and advance working time materially. Could we do this with Guayule? Decidedly not. Those planters must operate. So, when the winter rains hit us, fortunately very late in December, we folded. I was then transferred to the Riverside and Oceanside Districts, handling both until the end of the project.

Soil surveyors had been secured from the Agricultural Department to pass on all leased land. They had been given specifications for the soil types suitable for Guayule, which generally described a sandy loam soil. But I found everything from the heaviest black gumbo to almost pure sand on their accepted ranches. Consequently, numerous soil problems arose. On some of the heavier soils and on some areas not under irrigation, it was decided to raise Guayule by dry farming. On one ranch I visited near Winters in Yolo County, I found them planting a very heavy clay soil. When asked my opinion, I said that after the first rain they would not be able to put equipment on the land until late spring. After the winter rains started, the weeds began to flourish. They put Mexicans armed with hoes to work at a cost of \$500 per day. After about a month of this, during which the overhead made several visits, the area was abandoned.

On January 8, 1943, I left the Woodland area for the Southland. Mr. M.R. Lewis met me at Riverside, and we went over the Riverside and Oceanside areas, visiting the leases and getting oriented. On December 23, we held a meeting at Patterson with a number of the Salinas office personnel for orientation purposes, and to find out what the Guayule requirements were. As mentioned before, we had difficulty in getting decisions from the bosses, so we called for another meeting to iron things out. This was held at Bakersfield on February 8 and 9, and was attended by all supervising personnel. We on the firing line were loaded with our problems, so we had a pretty stormy session on the first day, but got nowhere. On the morning of the second day, Major Kelley, who was in charge of the Guayule project group, got up and said, "This is the biggest bunch of buck-passers that I have ever met; now, gentlemen, if you will give me your questions, I will give you the answers." At the end of that day, we knew where we stood.

Guayule personnel with whom I came in contact: Major Evan Kelley, Director; Paul H. Roberts, Assistant Director; Henry F. Blaney, Irrigation Engineer; M.R. Lewis, Irrigation; Kenneth B. Pomeroy, Leases; W.C. McGinnis, Chief of Surveys and Investigations; M.H. Lewis, Surveys; Francis Carroll, Personnel; Sampsell, Personnel; Henry L. Lobenstein, Planting; McCombs, Rickter, Billings, Surveys; Yarrus, Grapp, Leases—Riverside; W.W. Robinson, Leases—Riverside, Fred Leftwich, In Charge—Oceanside District; McCormick, Oceanside; Bell, Moore, San Onofre Mission Nursery; McClellan, Oceanside—San Mateo Nursery; A.A. Young, Miller, Richard I. Lowndes, Engineers—Riverside; Russel, Riverside; Moor, Surveyor—Oceanside; Arbuckel, Surveyor—Oceanside; Lundin, Surveyor—Oceanside; Britton, Salinas; John Beebe, Superintendent, San Mateo Nursery.

In late January of 1943, a very heavy storm hit southern California and the San Mateo River flooded the San Mateo Nursery. Mr. M.R. Lewis and I had visited the nursery a few days before, pointed out the danger of flood, and initiated action for corrective measures. When the flood hit, equipment was put to work within a few hours, and the nursery suffered only minor damage. To prevent a recurrence, it was decided to build a diversion dyke and face it with sacked soil cement. This was done and necessary drainage ditches built within the nursery to properly drain it.

On the Riverside District, two of the biggest leases were the Nelson and Phillip ranches. These were located near Banning and were on rolling ground. Contour planting was started to prevent erosion. After considerable

planting had been done, the area was visited by an extremely high wind of several days' duration. The contours were generally at right angles to the wind direction, so most of the leaves were blown off the Guayule plants. Although the old-timers claimed that the wind was very unusual, and had not occurred for many years, the area superintendent decided to plant his rows with the wind. This made most of them run downhill. The big storm mentioned before really worked havoc, and the erosion was very severe. We then had to install drainage systems to handle the runoff. The ditches had to be large, with wide bottoms and a flat gradient, and planted with grass. This required the use of heavy construction equipment. This equipment was rented and operators hired. After the work was well under way, the superintendent of equipment for the Riverside District decided that the operators should be paid the same as the operators of the farm equipment, and not union scale. Consequently, on my return from a trip to the Ocean-side District, I found the work at a standstill. To get things going, I took a Fordson operator and put him on a motor patrol grader. At the expiration of 3 days, when he was able to drive it across the field and move a little dirt, he climbed off and remarked that he would not operate that machine for that money. We then got our operators back and proceeded with the work.

Later, the order went out to plow up all of the unharvested Guayule and return the rented land to its owners. On May 20, I severed my connections with Guayule and returned to my former work.

One of the major oil companies reputedly stated, when our program was starting, that we might plant the Guayule but that we would never harvest it. Their synthetic rubber programs were making headway and they did not want the competition. At the close of the program, a plant for rubber manufacturing was in operation near Salinas, and a second had made its shakedown run at Bakersfield. Enough rubber had been made to assist in the war effort. I understand that the synthetic rubber did not have sufficient strength to stand more than a few landings of the big bombers, but by the addition of Guayule rubber, satisfactory tires could be made.

Los Angeles River Drainage Erosion Control

Early Construction

From 1941 through 1954, I took a very active part in the work on the Los Angeles River Drainage Erosion Control Program. This was started in 1941 as the Arroyo Seco Flood Control Program. It was suspended during 1943, due to the war, and then revived in 1944, as the Los Angeles River Drainage Flood Control Program under the supervision of M.B. Arthur. This name was later changed to the Los Angeles River Erosion Control Program. From 1945 to 1954, I devoted a considerable part of my time and the laboratory's time to this work, this being financed by the program. In 1941, I started initial work studying the soils and drainage problems of the Arroyo Seco drainage, the area being extended to cover all of the Los Angeles River drainage with the expansion of the program.

My first major work consisted of dam site aggregate exploration, including Fern Canyon, Brown's Canyon, and Ranger Station areas. The possibility of

using concrete aggregate from the Arroyo Seco Channel was thoroughly explored, with tests being made of samples from numerous areas. It was finally decided that it would be best to use material from commercial sources, due to the high cost of production, since 30 percent waste was necessary, and also to the low grade of this material. In 1944, a study was made of the possible use of helicopters in fire control in this area, and possible landing sites were selected and construction started on some of these sites. The following year, a transportation study was made of the roads necessary for fire control and the proposed road system completely revamped, with priorities set up for the roads considered necessary. Erosion and debris problems were considered, and about 30 percent of the original system dropped. The Lower Brown's Mountain road was selected as a guinea pig project. Its proposed extension to Brown's Mountain was abandoned, due to the high cost of meeting erosion control standards, and a new project built to Brown's Mountain from a point higher up the mountain.

The entire Lower Brown's Mountain project was rebuilt to the new drainage and erosion control standards and the surface oiled. Fill slopes were stabilized and many types of revegetation tried.

Erosion Control & Vegetation

Gus Jurhens, who was a native of and educated in Sweden, started work with the project in 1944. He had been a silviculturist on the Plumas Forest and previously in charge of erosion control work for San Diego County, having worked in the Palomar Mountain and other projects for them. He was an outstanding man at this type of work. He secured the cooperation of Dr. Fritz Went and through him was able to get studies made of plants that would be suitable for our climatic conditions in the California Institute of Technology Phytotron, a greenhouse adapted to study climatic and light effects on plants. He was instrumental in getting growth studies set up in a Cal. Tech. greenhouse, manned by Forest Service personnel, to study the soils and plants of this area and the effects of fertilizer treatments. He interested me in his work, and I cooperated with him from 1944 until my retirement in 1957. This included field and laboratory work.

I had previously started work studying the soils on the fills of the Angeles Crest Highway. This was expanded under his supervision to studying the plants growing on these and other fills. Folial analysis was made of plant material of selected varieties over a period of time, and the mineral content of these plant leaves related to soils and soil moisture conditions. Gus made studies of the growth in the various soils of the area, based on geologic types, and the effect of various fertilizer treatments. This study was extended to several fill slopes. Bouyoucus blocks, made of plaster of paris with included electrodes, were calibrated for the soils in which they were to be installed, and moisture measurements, related to rainfall, were made on several slopes.

Preliminary papers and reports were written on vegetative analysis, plant and moisture relationships, soil ratings, and soil and plant relationships.

Soil Creep Studies (1951-54)

The movement of soil is an important factor in combating erosion, so studies were instituted to obtain data on this phenomenon. Several hillside sites were selected for this study, involving variations in slope and type and

density of vegetation. Contour flumes were installed. Half-circle corrugated pipes were used, firmly anchored and tied into the slopes with soil cement. Debris were collected periodically and weighed. The percentage of mineral and organic material was determined. Rainfall data were obtained and related to the soil movement. A report was made of the findings. It is interesting to note that more material was moved during the dry period than during moderate rains. In fact, the early rains actually slowed up the movement.

Concrete Design

Our laboratory did exploration for sources for concrete aggregate and designed the concrete for Brown's Canyon Barrier, concrete cribbing, water tanks, and other uses.

Soil Cement

We promoted the use of soil cement in road drainage structures and canyon barriers.

Road Oiling

We set up the specifications and assisted in the oiling of several roads in this area including, Charleton-Chilao, Lower Brown's Mountain, and several military installations.

Soil Vegetation Studies

Soils were collected from the various geological formations on the basis of soil development and shipped to the University of California at Berkeley. Here, under the supervision of Dr. Hans Jenny, growth studies were made using standard accepted methods developed with agricultural soils. On the basis of these studies, the soils were rated for growth potential. This is covered in a printed report entitled "Nutrient Status of Brushland Soils in Southern California" by Vlamis, Stone, and Young and printed in *Soil Science*, Vol. 76, No. 1, July 1954. Jack Fisher had a very active part in this study and his name should have been included.

Aerial Studies for Fire Control

The first consideration of the use of aerial transportation in fire control was made in February 1944. We had been making extensive studies of road maintenance and had made road condition surveys on many of the Forests. These I started in 1940, and Marvin Shock and Gerald Mitchell continued the work. From 1932 through 1936, transportation studies for fire control roads had been made for all of the Forests. I was called to the Regional Office for a review of the condition surveys, and at this meeting, lasting for 4 days, the possibility of the use of aerial transportation in fire control was thoroughly discussed and guidelines set up. It was decided to explore the possibilities with several of the Forests.

Accordingly, in the following week, R.E. Lane and I journeyed to Santa Barbara and started the study, assisted by Forest personnel. This study lasted a little over a month, and after a report was submitted, it was decided to make brief surveys of several northern Forests. Accordingly, the Klamath, Shasta, and Mendocino Forests were visited and their views obtained. From this collected data, a final report was issued on the possible use of planes and helicopters in fire control.

Late in the year, with the assistance of Angeles Forest personnel, I made a transportation study of the Los Angeles River drainage for the redesign of the fire transportation system, incorporating the use of helicopters and locating helicopter landing sites. The construction of these sites was begun immediately, and the active use of helicopters started.

Equipment Tests

Motor Patrol Graders

From their advent, the Forest Service used motor patrol graders for road maintenance work. The Caterpillar was preferred by most of our operators as being reliable and, being the first on the market, was the most familiar. It was manually controlled and hard to operate; the operator was usually pretty exhausted by the end of the shift. Then Allis Chalmers came out with hydraulic controls, which eased the operation to a great degree. We had a number of their machines. Then the Rome grader came out. It was made in New York and became a competitor for our business. It was a hydraulically controlled machine and had several features that appeared to be desirable. In 1948, it was decided to test these machines competitively. Eugene Silva, who was in charge of the Equipment Development Center, and I were given the assignment—he to assay the mechanical features and I to handle the construction. We drew up a program and chose a site on the San Bernardino Forest for the work. The Caterpillar, Austin-Western, Allis Chalmers, Adams, Warco, and Rome companies supplied machines and operators. We selected a Forest Service operator for each machine, and the tests were on. Movies were taken of all operations. Our operator and the company operator did like assignments. The Rome grader was difficult to keep in operation, as it was poorly designed. At the conclusion of the tests, the Rome Company fired their design engineer and put out another machine. This we tested alone in 1950 and found satisfactory. We suggested to the Caterpillar representatives that they put hydraulic controls on their machines. Being very conservative, they demurred, but several years later they did so.

The Warco Company put out a rubber-tired grader, which we tested in 1951. At that time, we were building a recreation road at Barton Flats on the San Bernardino Forest. It was thought that this grader might have value in fire-fighting work. The grader developed difficulties with its clutch, which was made up of multiple plates, and its tires were easily punctured by the sharp stubs of brush left by the clearing crew, so it did not appear to be suitable for our work.

Soil Surveys

Soil being one of the basic resources of the National Forests, I was always interested in the advancement of soil surveys. For many years, the Forest Service in Region 5 had made plantings of timber in which the survival rate was very poor. This could have been avoided had the plantings been preceded by surveys to determine if timber could grow in these areas. Many brush areas could be planted to timber—others could not—due to the soil type. Some brushlands are adapted to the growing of grass in economic amounts; others can grow only brush. A soil survey is necessary to determine the Forest land uses in resource development. The method of soil survey now in general use was developed by Dr. R. Earl Storie of the University of California. Under this system, the soil is classified according to the parent material, general depth of development, type of cover, etc. The



Le Torneau dozer test, San Geronimo Truck Trail, San Bernardino National Forest, 1948.

soil is usually given a name from the first point of discovery and carries that name wherever located henceforth.

T.R. Littlefield, who headed up topographical surveys in the Regional Office and later Water Resources, was very active in promoting this activity. Initially, an area on the Mendocino Forest was selected, and soil surveyors from the Soil Conservation Service were secured to initiate the work. Later, the work was conducted under the supervision of the Experiment Station at Berkeley, cooperating with the State of California. A.E. Weislander initially headed up this work for the Station, assisted by Bob Gardner. Bob took over when Weislander retired. Bob was followed by Robert E. Nelson, and when he went to Hawaii, by Wilford Colwell, who now heads up the unit.

Lee Thomas, who was Supervisor of the Mendocino Forest at the time of the initiation of this work, became very interested and was instrumental in having his Forest the first covered.

I attended several schools conducted by the Experiment Station giving short courses in soil surveying, and gave some lectures at them. The Regional Office transferred Kenneth Bradshaw from the Experiment Station to the Regional Office to make special surveys of needed sites. Jack Fisher, who graduated from the University of California with a degree as Soil Scientist, having taken his work under Earl Storie, was on our laboratory staff for a number of years. He transferred to the Experiment Station and conducted soil surveys for several years before transferring to Region 6 for like work. He recently transferred back to Region 5 with headquarters in Redding on the Shasta-Trinity Forest.

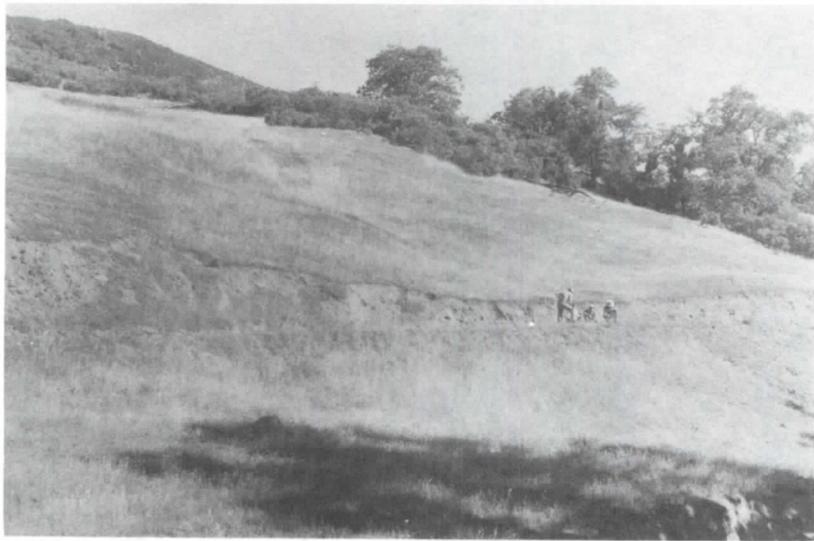
The accompanying photos illustrate the various types of cover growing on a few of the soils found on the Mendocino Forest. Until we have soil series



Soil Survey School, Mendocino National Forest, 1952. (Soil series are characterized by parent material and cover.)



Climax series, grassland cover, Mendocino National Forest.



Laughlin series, grassland cover, Mendocino National Forest.



Maymen series, brushland cover, Mendocino National Forest.



Josephine series, timber cover, Mendocino National Forest.



Henecke series, brushland cover, Mendocino National Forest.



Hugo series, timber cover, Mendocino National Forest.



Los Gatos series, brushland cover, Mendocino National Forest.

maps of our Forests, we are working in the dark in trying to develop the various Forest resources.

The properties of each soil—vegetative, engineering, and erosibility—were published by the Experiment Station. Soil vegetation maps were also published.

Tests of Stabilizing Materials

In the search for means of stabilizing roadbeds, the laboratory ran tests on a number of materials recommended for stabilization. The processors of forest materials have a byproduct from some of their manufacturing processes consisting of the lignin of the trees. One company in the Pacific Northwest sells this under the name of Raylig. They sent us a representative to assist in evaluating this material. We installed some trial sections but found it unsuitable for our conditions. Where it was used in the Washington-Oregon country they have rainfall throughout the year. In California, we have long periods of no rainfall. Under our conditions, with no addition of moisture, the material would be brought to the surface by capillarity, where it would be powdered under traffic and blown away.

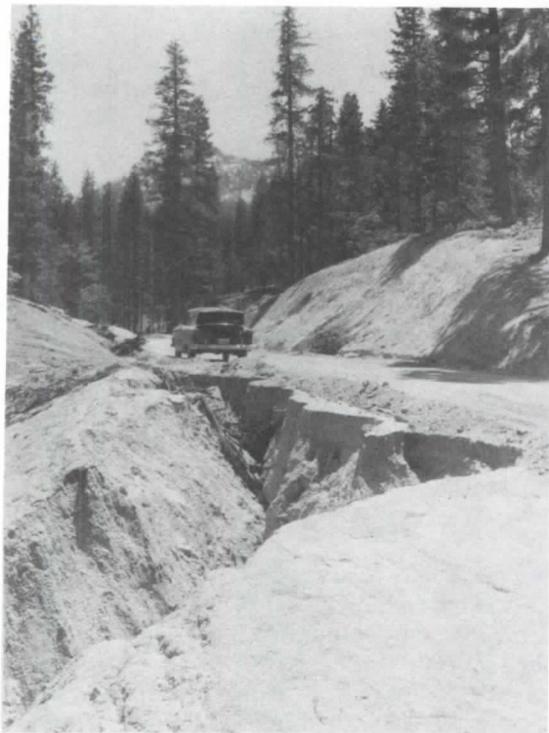
The Portland Cement Company was interested in the use of Portland cement mixed with the native material as a road-surfacing material. We set up a project at Northshore Campground on the San Bernardino Forest to try it out. The Portland Cement Company sent an engineer from their headquarters in Chicago and another from their San Francisco office to direct us in the work. The campground roads were paved with this material. We found after a period of time that it tended to ravel, so we applied a penetration road oil surface to take the wear. However, we found soil cement to be an excellent base stabilizer and used it for this purpose on many roads. The State of California Highway Department watched our experiment, put in test sections of their own, and adopted it for wide use in base stabilization. Calcium chloride was tried out, mixed with the native soil, as a means of roadbed stabilizing. Although it was used with success in many areas with rainfall throughout the year, we found the same difficulty as with Raylig. Without constant rainfall, it would not stay in the soil and so lost its binding power. Besides, when windblown, it gave a very disagreeable dust.

The Shell Oil Company was interested in trying out the stabilizing power of various road oils or special oils. We set up a number of test sites on the Mammoth Road on the Sierra Forest, they furnishing the oil and the Forest Service doing the work of application. Mr. Victor Endersby was in charge for the oil company. The results were not such as to recommend this process for future work.

We ultimately developed the dust oils for use on logging roads.

Sierra Forest Mammoth Road Project—South Fork to Chiquito Basin

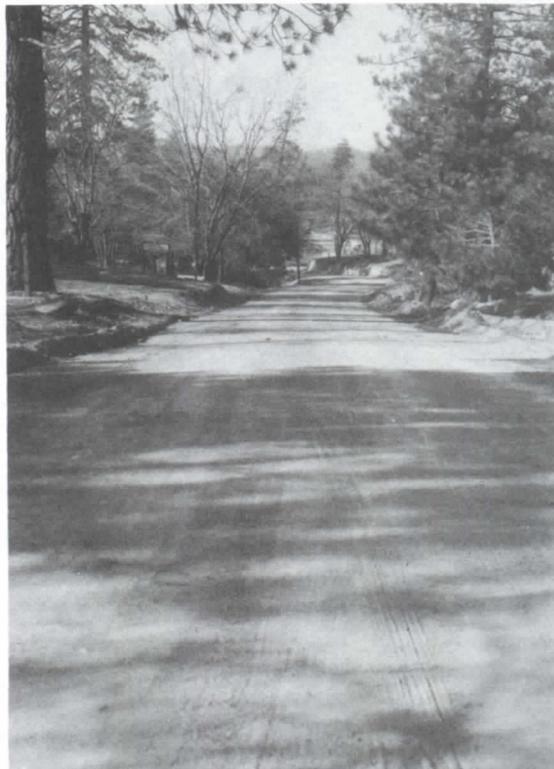
This project is a logging road principally built for the purpose of removing the timber from the Chiquito Basin to the sawmill at South Fork, adjacent to North Fork, which is about 40 miles northeast of Fresno. It was projected to extend to Mammoth Pass, thus giving another trans-Sierra highway. The portion from South Fork southerly for about 6 miles is on the location of an old county road. The next section, about 8 miles in length to the intersection with an old settler's road extending over the mountain from South



Fill slope damaged by runoff from improper drainage, Mammoth Road Station 59+67. Left: Looking down road. Right: Looking across fill.

Fork, was built by the Civilian Conservation Corps about 1936–37. A few years later, the next section extending from this section to the Hogue Apple Ranch, another 6 or 7 miles, was improved by the CCC. This was a continuation of the old settler's road from South Fork. From here, a new section was built by the CCC for about 5 miles further. From this point, two sections totaling about 15 miles to Soda Springs were built by the Bureau of Public Roads under contract, and the final section to Chiquito Basin and beyond was built by the South Fork Lumber Company.

The first section to be reconstructed to meet logging road standards was the county portion. This involved considerable realignment as well as widening. Up to this time, about 1935, all Forest Service road construction had been to very minor standards. Bene Benedict, the Forest Supervisor of the Sierra Forest, was all for the reconstruction but was amazed by the resulting road. "To think," he said, "that I should ever live to see the Forest Service build a road like this." In 1943–44, the then existing portion of the road was oiled under the supervision of Harold Howard, the general foreman of the Sierra Forest. Much of this portion did not have adequate width and alignment for logging trucks, and was reconstructed with minor realignment. In 1950, it was decided to improve the road with minor realignment and a reoiling job. Previous to this time, the laboratory was called upon to make a subgrade survey to determine roadbed stabilization requirements and sources of borrow material. Irving Sherman was in charge of this work.



Finished section of roadway, North Shore Campground, San Bernardino National Forest, 1937.

In 1951, in cooperation with the Shell Oil Company, represented by Victor Endersby, five trial sections of base stabilization using several types of cutback road oils were installed together with a section of soil cement stabilization. In 1952, the project was reoiled.

The two sections built by the Bureau of Public Roads were constructed by their method of cut-make fills with minimum overhaul. No consideration was made for overhaul for the purpose of stabilization. After the construction was completed, I was called in to make subgrade surveys to determine the necessary work to be done before oiling was started. Borrow pits had to be located, deficient areas repaired, and material imported for base stabilization. Most of this work could have been done at the time of construction by judicious use of the available material, with a comparatively small amount of additional overhaul. Drainage was usually deficient and had to be corrected. The first winter after the construction of each section, rainfall damage was excessive, and I was called in to outline and estimate the cost of the needed repairs. This amounted to several thousand dollars per mile. I went over the project with a Washington inspector after one disastrous winter, viewing the damage. In commenting on the type of construction done by the Bureau, I remarked that Buck Lane, in charge of Roads and Trails, said, "We have to take a calculated risk." "Calculated,



Soil cement check dam 43, Coon Canyon Angeles National Forest, 1953.



Sacked soil cement revetment, West Fork San Dimas Truck Trail, Angeles National Forest, 1941.

hell," said he, "we know very well that if we build a road like this, we will have this kind of damage."

In 1953, we had to install extensive additional drainage, and in 1955, after the construction of the second section by the Bureau, we spent about \$50,000 in flood repair and drainage installation. The construction by the logging company of subsequent sections was closely supervised by the Forest Engineer, Paul Googins, with a much better road resulting.

Soil Cement

The Portland Cement Association started the promotion of the use of soil cement in California in 1937. Soil cement consists of the addition of Portland cement in predetermined quantities to the naturally existing soil for stabilization purposes.

The campground roads at Northshore on the San Bernardino Forest were selected as the first test areas. Soil tests were made by both the Portland Cement Laboratory in Chicago, and by our Soil Laboratory, which was just being started at this time. This job was done during the month of September using CCC crews. The Portland Cement Association furnished cooperating overhead. As this was the first job to be done west of the Mississippi River, it was observed with interest by the State of California Highway Department and other agencies.

The State of California then started a job at Keck's corners in Kern County, which we watched with interest. A year later, we returned to Northshore Campground and did further drainage work using a rototiller for mixing. We also applied an oil coating, as we found that the soil cement was not taking traffic wear, and decided that it should be used for soil stabilization and not as a wearing surface. We were having difficulty with the lava soils of northeastern California, particularly on the Shasta, Modoc, and Lassen Forests, as they both washed and blew away. We made extensive tests with these soils in the laboratory, and found that cement would not act as a stabilization agent except when 7 percent of lime was added. The costs of this treatment were considered excessive so no trial sections were installed.

In 1940, we installed a sacked soil revetment to stabilize the banks of a stream in Bluejay Campground on the San Bernardino Forest. In 1941, we installed several aprons at drainage crossings on the Applewhite road on the San Bernardino Forest. Both soil cement and asphalt were used at different sites. The soil cement aprons were given an asphalt protective coating in the following year.

During the Guayule program, we installed sacked soil cement to protect a dike revetment at the San Mateo Nursery to prevent flood damage. In 1945 and 1946, numerous channel check dams were installed by the Los Angeles River Flood Control unit to control channel cutting. A large section of Coon Canyon was treated in this manner. These structures had the appearance of being built of concrete. Native material from the sites was used and water taken from the stream. The cement was packed or highlined to make very economical construction. In 1953, a soil creep study was made at several sites on the Los Angeles River Drainage. Metal flumes were used to catch the debris, and these were tied into the slopes by the use of soil cement.

These structures had one advantage over concrete structures. The soil cement being made of the local material, backfilling made a perfect bond with the structure, so there were no settlement cracks between the structure and the hillsides, as often occurs when concrete is used.

Soil cement was used as a base stabilizer on unstable sections of numerous roads, being particularly valuable for the treatment of clay pockets. It proved to be valuable material where the natural soils are suitable for its use or where suitable soil can be imported.

Campground Road Construction & Oiling

The campgrounds in the California Region have always been heavily used. To start with, they were very primitive, consisting of tables and stoves marking camping spots, with primitive water supplies, a spring or stream, and inadequate sanitary facilities of the Chick Sales type.

With the advent of the automobile, these areas began to be congested and the facilities overrun, with consequent damage to the native vegetation. Use so far exceeded capacity that in some areas tents were practically touching. To remedy this condition, barricades were installed and definite campsites delineated. The barricades consisted of logs, rocks, or posts. In many campgrounds, the cars had to be parked at some distance from the campsite and the camping equipment carried in. Many campers did not approve of this setup, with the result that the barricades were removed or pushed over by the cars, and the car or trailer parked by the campsite. There arose a sharp disagreement among the members of the Forest staffs, who had charge of this activity, and the members of the Regional Office of Lands, both groups being divided on the subject. At last the campsites were redesigned, where possible, so that the auto became an integral part of the camp. With the advent of house trailers, difficulty arose with the trailers being too big for parking sites, and from their preventing the use of stoves and tables that they did not need. Out of this came the redesign of the campgrounds, with each car camp having a carport, either for its exclusive use or in conjunction with adjacent camps. Carports for trailers were built, usually in a separate section of the campground, and so marked. Barricades were redesigned, the logs set at a height below the car bumper where they could not be pushed over; also, large, partly buried rocks were used.

With heavier use, dust became a problem, not only on the roads, but in the camping areas themselves. The laboratory was assigned the job of finding a dust palliative for the camping areas. Several were tried, but none was found that would do the job without being toxic to either the vegetation or to the people, or that was not objectionable. Our long dry periods prevented the use of material that required moisture to keep it in place.

This idea was then dropped and attention turned to dust-proofing the roads. Asphalt paving was accepted as the answer, and the Materials Testing Laboratory was given the job of doing this work. Starting in 1948, we began active work on the oiling and often construction supervision of the recreation roads. Administrative sites were often included. Usually, the Forests did the actual construction, while we took charge of the oiling, since the Forests did not have personnel experienced in this work. In 1955, Leonard Stern was put in charge of the field work, with Robert Hunt as assistant. Previous to that time, I handled the field work personally. The Inyo Forest had no Forest Engineer in those days, so we handled much of their survey work, as well as direct supervision of construction and oiling. Most of this work was done by force account, as we could not find competent contractors who were interested in this type of work. The Laguna Campground on the Cleveland Forest was paved in 1949, and I had to personally supervise the contractor's crew, at his request, for he did not know what to do. On the Arroyo Seco Campground paving, Los Padres Forest, in 1956, we let a contract to a State highway contractor working nearby. He did a good job but announced that he was done with that type of work, as it was too difficult. He did not enjoy the narrow roads, sharp curves, and steep gradients. The same year we let a contract to a local man on the Inyo Forest, who was

also doing a State job. Usually, there was no State work being done in the vicinity of our jobs, so we had to do them ourselves.

On this work, we ran afoul of the Federal Eight-Hour Law. This law was passed in 1891, but not recognized by the Federal Government itself until many years later. Somebody dug it up, dusted it off, and sprung it on us. It had always been the custom in the Forest Service to allow compensatory time when overtime work was required. Usually, this was accumulated and allowed on Friday afternoons, the time reports not showing the change. This practice was agreed to by the Fiscal Agent's Office and by Operations. Out of the blue, two members of one Forest's staff were called up on the carpet, and fined for falsifying the records, by an overzealous member of the Fiscal Agent's Office.

In construction work, it is not always possible to complete a section of the work by quitting time, no matter how carefully the planning is done. Equipment can break down and delay the work, or the unit of work can be just too big to be done in the 8-hour day. A good example is pouring the foundations for a building, which must be done as a unit. In paving work, the road oil usually has to be hauled long distances, and delivery is usually scheduled for 7 a.m. If the oil truck breaks down en route, it may reach the job at 3 p.m. It has to be unloaded immediately. The oil must be applied hot and cannot be allowed to stand overnight. It cannot be dumped, not only because of its cost, but also because there is no place where it will not create damage or a problem. The workers are interested in their jobs and readily agree to overtime work, with compensatory time off. Unfortunately for us, this happened on the Forest where the personnel had been fined. They reported the incident to protect themselves, and Len Stern, in charge of our unit, was on the spot. On review by our Washington Office, it was ruled that there was no criminal intent and the case was dropped. This brought up the necessity of advance overtime approval by the Division of Operations. They were loath to grant this in advance of the emergency, so it was required to contact them by telephone for approval. This was often difficult from isolated jobs. At this time, overtime approval is easier to obtain.

The following is a list of the major campground and administrative sites paved and the year the work was done. More than one year shown for the work may mean a repaving job or advance work in construction, planning, or laboratory work.

Ranger Station & Headquarters Yards

Angeles

1948-50
1948-49-55
1949
1955

Table Mountain
Crystal Lake
Chilao-Charleton Flats Area
Dalton Tanbark Station

Cleveland

1949-55
1949-52-53-55
1952

Burnt Rancherio
Laguna
Descanso Ranger Station

Los Padres 1952-55-56 1952	Arroyo Seco Chuchupati
Modoc 1951	Headquarters
Tahoe 1952 1952-54-56 1955	Big Bend William Kent Big Bend Ranger Station
Plumas 1953-54-55 1953 1953 1953	Ganser Bar Quincy Yard Vicinity Chester Brush Creek
Inyo 1953 1953 1955-56 1955 1955-56 1956	Shady Rest Mammoth Ranger Station June Lake Gull Lake Twin Lakes Mammoth Lakes
Lassen 1953 1954	Susanville Yard Almanor
San Bernardino 1949-50 1949-50 1951 1956	Coldbrook Lytle Creek Ranger Station Del Rosa Warehouse Site Barton Flats Campgrounds
Sequoia 1951-52-54-55-56 1952-55	Hume Lake Quaking Aspen Ranger Station
Shasta-Trinity 1951	Redding Ranger Station
Sierra 1950-51 1953-54-55	North Fork Administration Site Bass Lake Campground Site
Stanislaus 1950-51-53-54	Pinecrest

Specifications for Erosion Control on State Highways

In 1946, the State of California was preparing their plans and specifications for the construction of the City Creek Highway on the San Bernardino Forest. I was assigned to assist in the writing of the erosion control specifications for Regional Office approval, since much of the location was over Government ground. Gus Jurhens, silviculturist with the Los Angeles River Flood Control project on the Angeles Forest, and in charge of erosion control on that project, had previously been with San Diego County and had put in several very successful erosion control projects for them. These included the Palomar Mountain project.

A trip was arranged to view these projects to collect data for the specifications. The State Assistant District Engineer, Mr. Switzer, the State Landscape Engineer, Mr. Bower, the San Bernardino Forest Engineer, Jay Spencer, Gus Jurhens, and I made up the inspection party. We journeyed to the Cleveland Forest and went over Gus' projects, then visited several projects on the San Bernardino Forest, including the City Creek project, which roughly followed an existing road. Following this, we held an all-day meeting at Flood Control Headquarters on the Angeles Forest. This meeting also included Angeles Forest personnel. As a result of this meeting, specifications were drawn for the erosion control and planting of the City Creek Highway. These were approved by the Regional Forester and became standard for future work. The State complied with these fully, even exceeding them in some respects.

In 1949, we drew up similar specifications for the Mill Creek Highway built on the San Bernardino Forest by the Bureau of Public Works as a Forest highway and taken over by the State for maintenance. In 1950, we drew up the specifications for erosion control and planting on the Cajon Highway through Cajon Pass, for the State's reconstruction of that route.

Logging Road Surveys & Construction

At the close of World War II, the demand for timber products resulted in a large construction program for logging roads. I was given charge of several projects on the Stanislaus and Sierra Forests, to supervise surveys or both the surveys and construction. They were:

- | | |
|------------|---|
| Stanislaus | 1946 through 1948. Sawmill Mountain Road in the Tuolumne Ranger District. Morton was chief of party on surveys, and Ralph Wonsler was construction foreman. |
| Stanislaus | 1946 through 1947. Bull Creek survey with headquarters at Kinsley Guard Station. Chas. Smith, Chief of Party. |
| Stanislaus | 1947. Bell Meadows Survey—Dorrington Survey. |
| Sierra | 1947. McKinley Grove, Survey and Construction. McKelvy, Chief of Party; Harold Howard, in charge of construction. |
| Sierra | 1951. Ross Crossing Survey; McKelvy, Chief of Party. |

In 1947 and 1948, I handled the survey and construction of the San Geronio recreation road on the San Bernardino Forest. McKelvy was Chief of Party, and Francis Robbins was in charge of construction.

Winton Lumber Company Road

In 1946, a contract was entered into between the Winton Lumber Company and the Forest Service for the construction of a logging road on the Stanislaus Forest. This road connected with State Highway No. 88 near West Point and extended southerly for a distance of about 20 miles, replacing an old substandard county and Forest Service project.

Under the contract, the Forest Service was to furnish the necessary culverts for drainage and to stabilize and pave the entire road. The Winton Company was to furnish the survey and do the construction. I was assigned supervision for the Forest Service, to oversee the drainage work, design the stabilization and paving, and have charge of the latter contract. I assigned Harold Meyers to do the field surveying for the determination of the stabilization requirements and to find sources for borrow material. The laboratory did the necessary testing work and wrote the specifications. One of the requirements of the contract was that the Winton Company give the U.S. Government title to the road.

In 1947, the contract specifications were drawn, bids called for, and all made ready to proceed with the job. The Winton Lumber Company secured the necessary rights-of-way from all landowners except Walter Johnson. The road crossed one 160-acre tract of his land and was built under an agreement between the Winton Company and Johnson under which each could build roads over the other's land to serve their respective sawmills, but the roads could not be dedicated for public use. There was a timber holding company that held a large acreage in this area, which Johnson had always considered as being available to him when needed. The Winton Company, when extending their operations to this area, acquired these holdings. This made Mr. Johnson very unhappy, so he refused the necessary right-of-way. The Winton Company was therefore unable to fulfill their end of the contract. Accordingly, the Winton Company was forced to reimburse the Forest Service for the culverts that the Forest Service had furnished and proceed with the stabilization and paving at their own expense. The Forest Service funds were transferred to another project on the Stanislaus Forest.

Paving & Construction at the Stockton, Redding, & Arcadia Equipment Depot Sites

From 1940 through 1944, extensive work was done at the three Equipment Depots. These depots were developed as centers for the repair and maintenance of equipment for the adjacent National Forests. The Arcadia Depot was started in 1940, having previously been located on a rented site at Glendale. The Arcadia site belonged to the Angeles National Forest and was used as a Forest Fire Control and warehouse center. The southern California fire warehouse and dispatcher were located here also. In 1939, the Materials Testing Laboratory was started here, and later the Equipment Development Center moved in.

The Equipment Depot built a new central repair building and took over an existing Angeles Forest building, which was used as a machine and blacksmith shop. Later, an office building, storage sheds, and other structures were added.

William Corum was the first Superintendent when the plant was located at Glendale. He was succeeded by Verl Jeffries, and upon Verl's death, Don McFarland took over and is still in charge in 1967. When the Angeles Forest took over the site, it was graded with a slope from north to south. They also placed a penetration oil surface on the eastern portion of the yard, where their principal buildings were located. Further buildings were constructed as needed without additional grading. This resulted in very poor drainage with pools of water on the upper side of the buildings after each rain.

In 1944, I was assigned the task of regrading the yard and paving it. The work was completed that year. The base material had adequate supporting ability when dry but became very unstable when wet. The logical answer was to put a roof over the yard rather than import base material. A hot plant asphaltic material was therefore used, which was designed as a very dense mixture with a high asphaltic content. This did the job very well and is still in use with but minor repairs.

The Stockton site was acquired in 1939, being a gift of the City of Stockton. My first duty was to locate the site, which was a bit difficult, due to an error in a previous survey and a mislocated fence. However, this was finally accomplished with the assistance and agreement of the Stockton City Engineers' Office. This site was subject to overflow by floodwaters from a creek to the south. One local resident told me of traveling over the area in a boat on a previous winter. The top 2 feet was Stockton clay adobe, which has a supporting power of zero when saturated. Plans were therefore made to import from 1.5 to 2.5 feet of material to raise the yard above flood level. Under the adobe was a layer of hardpan, which the Stockton Building Department considered capable of supporting 1.5 tons per square foot. I worked with the Structural Design Department, and we came up with a design in which the building foundations would be supported by concrete posts set on the hardpan. As the warehouse floors were at truckbed level, this altogether required the importation of a large amount of fill, since there was about 6 acres of site.

After the site survey and basic design, the construction work was set up as a WPA job with a local construction foreman in charge, and WPA workers and financing being used. Things did not go well, so I was reassigned to handle the work. With the local foreman still on the job, this made a difficult situation, but it was soon resolved by the foreman's son, a lad of about 12 years, accidentally shooting and killing his father when being instructed in the use of a .22 rifle by his father.

A fleet of old trucks had been assembled to haul the fill from a site about 3.5 miles to the south. Loading was by hand as was spreading in the yard. The yard was full of forms for final grade, which impeded unloading and necessitated much wheelbarrow work. I immediately removed the forms, set grade stakes, imported a maintainer, and got the job rolling. The personnel under the original conditions were doing practically nothing, not having their heart in the work, but this rapidly changed, and they became a good crew when they could see progress. One day, I heard two of the men talking, one chiding the other for working so hard. The second said, "It isn't like it was last week; now you got to work or get off the job." On later

construction work after WPA, I rehired some of these same workers and found them good men.

There was a gasoline shovel standing idle at the Equipment Depot. Upon inquiry, I found that it could be put in running condition for \$150. I had it repaired and set it to loading trucks. This worked fine. The dirt really started rolling onto the job, and the morale increased materially. This worked for about a month until the Regional Office learned about it and made me remove it. It appeared that the funds available for construction material were based on the man-hours put in, and I was depleting their funds. However, by that time we had most of the fill in place. We mixed the concrete for the foundations on the job. Most of these buildings were very large, and it was just not possible to mix and place that much concrete in the 6-hour workday allotted to us. There was abundant manpower, but it could not all be used on one building. So, one night I ran overtime to finish the job. The next day, a WPA representative from Sacramento was on the job, with blood in his eye. It appeared that I had violated a Federal regulation and was subject to all kinds of dire penalties. "Well, what can I do under these circumstances? The concrete must be poured as a unit, and it is not possible to work over 25 men at a time." His reply was, "Have the necessary number of men stop work, and sit by until the shift is concluded, then put them to work." It sounded a bit illogical to me.

The initial paving was done in 1941. To prevent heaving of the yard surface from the adobe underneath, I fully saturated the subbase material underneath. With the 1.5 to 2 feet of imported fill material and the oil to prevent evaporation of ground water, it gave a stable yard. The surface was mixed in place from gravelly material purchased from a local contractor. The south yard was not oiled at this time. In 1942, paving repairs were made around a filling station and an additional building. In 1944, the south yard was paved and a new plant-mixed surface applied to the whole area correcting some drainage difficulties, and getting a stable wearing surface, as difficulties developed from the original mixed-in-place job. This work was done during the war. We used a five-man crew of conscientious objectors borrowed from the Sierra Forest, Forest personnel, and some local help. The conscientious objectors were an excellent group with a religious background. This work was done at the same time as the construction and paving work at the Redding yard, wartime travel between the two jobs presenting considerable difficulty.

The Redding Equipment Depot site was loaned by the City of Redding. It was situated in a swampy area with a water table very close to the surface. The initial buildings were constructed without an adequate drainage or stabilization plan. Difficulties developed, and the CCC was called upon for help. They imported huge amounts of dredger cobbles to get stability. The cobbles sank through the swamp muck, and the yard was a mess. In 1941, I was called upon to develop a solution. Plans were made and the work started in 1942. At this time, it was decided to employ some women for depot work, so a dressing room and other facilities were added. Labor was very difficult to get, it being wartime, so we used a number of itinerants. Using them was like having a group of kids. There was a large shop building in the center of the yard, and I spent most of my time walking around it and breaking up the conversational groups on the other side. We found the yard level as much as 2.5 feet above the floor level of the main

building. This necessitated removing large quantities of clay and dredger cobbles to get drainage. To do this, we had to use a large ripper. The yard was full of underground utilities, gas, water, telephone, power, etc. It seemed that every time the ripper crossed the yard, up came some type of conduit. The office crew became quite annoyed several times a week.

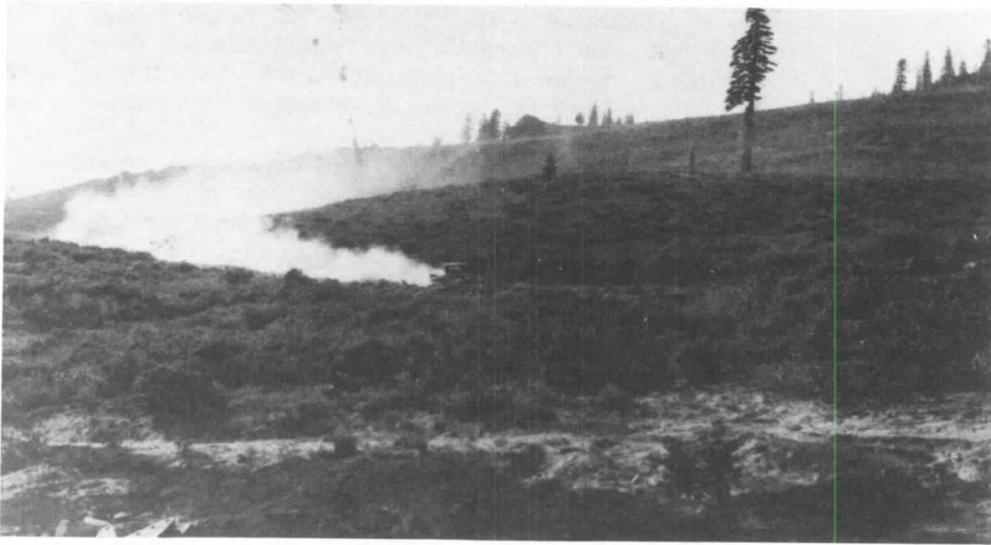
We finally established subgrade, restored the utilities, imported a base, and got the oiling started. For base, we used about 6 inches of crushed rock, which we obtained from a local plant. Their stockpile had been flooded the previous winter and the material filled with silt, so we got a bargain price. It worked fine for us. We penetrated this with road oil, and the following year placed a plant-mixed surface over it. We ordered up a carload of oil from Richmond. The oil failed to show up, so we put a tracer on it. I called up the railroad yard at the division headquarters to the south and asked the dispatcher if he was holding car number so and so, and to please look for it. He said, "I don't need to look for it. It has been sitting outside my office window for the past week." So I requested that he add it to the next train north. Wartime traffic was very heavy, but it finally arrived. I ordered it set on the City of Redding's siding. I had made arrangements with them for reheating, as by this time the oil was thoroughly chilled. I finally found it in the Shasta County yard and lost another day in having it moved. A couple of days later, two railroad representatives appeared on the job and demanded demurrage for holding the car overtime. I soon convinced them of their error. Labor was very hard to get because of the wartime activities around Redding. We had a janitor who was very good at going to Skid Row and rounding up derelicts for me. Usually, their stay was very short. One day, a union representative showed up on the job and bawled me out for not hiring his men. I informed him that the job started at 8 a.m. and the crew was filled before that time, and that if he wanted his men on the job, to get them there before 9 or 10 a.m., their usual time of appearance.

After the fall rains started, men were more plentiful. I hired an excellent bulldozer operator who lived in Redding. After a few days, he informed me that he would have to quit, as we were not paying the union scale, and they would fine him \$50 per day for any days he worked for us. He was living at home, so his net pay was better than on outside union jobs. The unions are so considerate!

In 1946, we paved a storage yard to the east and a small section on the northwest corner. The City of Redding has since taken this property back, and the Depot is now at the Redding Airport.

Dust Oiling

Due to the long dry summers, the dust problem on logging roads has always been severe. Not only is it a hazard for the traffic, it also results in severe depreciation of the rolling stock. On main haul roads, where justified by the volume of traffic, the best answer is roadbed stabilization and paving. On roads used for only a short time or where the haul is light, the cost for this type of treatment is not economical. Under these conditions, most operators resort to watering. Watering is at best unsatisfactory. It is expensive and, when interrupted by long weekends or fires, results in the loss of large amounts of road metal and a rough and bumpy road, with excessive vehicle maintenance and tire cost. To alleviate this condition, I was given the



Dust raised by pickup traveling at 15 mph, Shasta Trinity National Forest.



Completed section of road treated to dust oiling.

assignment to develop some type or method of stabilization that would be effective. Lignin binders, which result as a byproduct in the manufacture of timber products, were tried but were unsuccessful in California since we do not have sufficient summer moisture to keep them in the soil. They migrate to the surface and are blown away. Calcium chloride gave like results.

Various types of penetration road oils then on the market were tested, as was fuel oil. None proved satisfactory. These tests were started in 1939 and continued through the years as new products or methods were suggested.

The Golden Bear Oil Company of Bakersfield had a rosin that was a by-product of their lubricating oil manufacture for which they claimed success in desert sands, but it did not meet our problem.

Finally, in 1954, I heard that the Standard Oil Company was meeting with success in Oregon on their logging roads. Also, the major oil companies were developing a method of penetration using highly diluted emulsions. I visited several of the Oregon jobs as a guest of the Standard Oil Company and found that they were using a cutter oil to dilute a standard road oil for increased penetration, with considerable success. This cutter oil was of about the consistency of machine oil. It was used to reduce the viscosity of crude oil shipped by boat from Richmond to Portland, so was a surplus product at that point.

At about this time, William Seigfreid, who was the owner of the Paraco Oil Company of Fresno, got in touch with me. The Paraco Company refined used lubricating oil and had a waste product that he was selling to the local farmers for dust alleviation on farm roads. We tried this product but found that it did not have enough body. We then tried adding fuel oil to get more asphalt. Fuel oil alone had proved unsatisfactory because it oxidized too rapidly, the surface beginning to deteriorate in as little as 10 days' time. This did not prove to be the answer, so we changed to a heavy road oil addition. This worked fairly well, but by this time Seigfreid's reserve supply was about exhausted, so we had to look for a new source.

We installed a job using the dilute emulsion method advocated by the major oil companies and talked one lumber company into doing likewise. These installations proved quite satisfactory but were so technical that it took an expert to supervise work. Also, the close control of the subgrade moisture necessary to get a satisfactory job was difficult to secure in our areas of mixed sun and shade.

Having by this time pretty well defined the necessary ingredients for a successful dust oil, we set to work to manufacture one. We built a test tract in the laboratory, consisting of a circular runway with a power-driven simulated logging truck. This was designed to give similar roadbed pressures to those in actual use. Our objective was to get a road surface that was dust-proof and free from transverse chuckholes. Longitudinal ruts would not be too bad. Since this was to be applied to an unstabilized roadbed, and the loading was very severe, we could expect deterioration, which would require occasional reshaping. We needed a surfacing that would not get hard like ordinary road oils, but could be bladed and brought back by a small addition of the dust oil. We needed asphalt, a penetrant, and an agent to delay oxidation. The end product must not be expensive; in fact, it should be competitive to the road oils then on the market. For sources of supply, we had the oil companies for the road oils, and the oil companies or the used oil refiners for the penetrant. The oxidation retardant, which had to be in the lubricating oil classification, must be relatively cheap. The best source for this was used lubrication oil collected by the reclaimers. They usually had this in excess and sold their surplus overseas.

We designed three synthetic soils to range from fairly heavy clay to sandy soils, and started our tests. The Golden Bear Oil Company of Bakersfield, working under Dr. Roeseler, was using a method of analyzing petroleum

products, which we adopted. We secured samples of the various petroleum materials on the market and set to work. Applications were made on logging and other roads throughout the Region, and by 1956 we had satisfactory dust oils for all but volcanic and very sandy soils. For these soil types, by the time we had added sufficient asphaltine to bind the soils, we had a hard road surface that could not be bladed, thus passing out of the dust oil requirements. Our laboratory has now (1967) apparently found a penetrant that will do this job on the sandy soils.

The Triaxial Institute

The Triaxial Institute was founded in 1950, and the Forest Service was accepted as a member in 1951. We were almost a charter member. The Institute was organized for the purpose of devising and standardizing methods of design for base and surface of roads. The membership consisted of representatives of the following: the State of California and the Oregon Highway Testing Laboratories, the University of California, Oregon Agricultural College, the Shell and Standard Oil Companies, and the Forest Service. Membership rested in the representatives and not in the parent organization, but to be a member it was necessary to have an available laboratory.

Meetings were held once a year at Klamath Falls, Oregon—that being a central point—and lasted 2 days. Tests of base and surfacing materials were to use triaxial methods. Testing machines and testing methods had to be devised and standardized. Materials to be tested were exchanged, worked on by each party, and the results compared. The State of California representative was Francis HVeem, who was in charge of their highway laboratory. He had devised a stabilometer, which was accepted as a test machine. He had also developed a compaction machine, as had the Standard Oil Company. We likewise developed a compactor, which varied from theirs in being fully pneumatic. One provision was that compaction must be done without impact. The Standard Oil machine could not meet this specification, so was discarded.

HVeem had a leading role in this organization until his retirement. He was ahead of the rest of us in development and had a larger organization with better opportunities for tests in the field. The Triaxial Institute was accepted as a subcommittee of the American Society for Testing Materials. Upon my retirement in 1957, Harold Meyers, who was in charge of our Materials Testing Laboratory, was given my membership. This he relinquished in 1966.

Our association with this group enabled us to make material progress in developing testing machines and methods and in keeping abreast of the latest developments in testing.

Mining Claim Hearings

There have always been some individuals who try to find loopholes in the Federal mining laws for the purpose of making money, securing a home or business site, water rights, building material, or other objectives. Before the flood control dams were built in the San Gabriel Mountains, mining claim locations were made of all possible dam sites and borrow pits. Ole Freidoff, the Forest Service Mining Engineer, wished to invalidate these claims, but the Los Angeles County Flood Control unit did not want to be held up by the ensuing litigation and bought them out. This set a very bad precedent.