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	Engineer Memoirs MAJOR GENERAL HUGH J. CASEY	
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Engineer Memoirs

Major General Hugh J. Casey

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US Army Corps of Engineers

To the soldiers and civilians
of the Corps of Engineers
for their accomplishments during World War II.

Engineer Memoirs

MAJOR GENERAL HUGH J. CASEY

US Army

Office of History
US Army Corps of Engineers
Washington, DC

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Foreword

In January 1980, Lieutenant General John W. Morris, then Chief of Engineers, directed the Historical Division to capture the remembrances of the leading military and civilian members of the Corps of Engineers. The resulting *Engineer Memoirs* series shares the "lessons learned" from this rich and previously untapped resource.

This interview with Hugh John "Pat" Casey—seventh in the series of *Engineer Memoirs—is* the second that features distinguished World War H Corps of Engineers generals. It is a part of the Army's commemoration of the 50th Anniversary of that war.

This volume is an edited version of the tape-recorded interview conducted by Dr. John T. Greenwood, then Chief of the Historical Division, with General Casey at his summer home in Bradford, Vermont, from 25 to 29 September 1979. Before his death on 30 August 1981, General Casey reviewed and revised the entire transcript of the interview.

Pat Casey's remembrances are published because his reflections on a lifetime of successes in military and civil works assignments produce a valuable perspective for present and future decisions by the Corps of Engineers.

ARTHUR E. WILLIAMS
Lieutenant General, USA
Commanding

The Interviewer

Dr. John T. Greenwood was the Chief of the Historical Division and the Office of History, Headquarters, US Army Corps of Engineers, from February 1978 to November 1988. He is now the director of field and international programs for the US Army Center of Military History in Washington, DC. He holds a Ph.D. in military history from Kansas State University, Manhattan.

Acknowledgments

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Hugh John Casey

Major General Hugh John "Pat" Casey will always be remembered as General Douglas MacArthur's chief engineer because his greatest achievements as an engineer came during his eight years with MacArthur. From the desperate fighting on Bataan through the long months it took to drive the Japanese out of New Guinea and the Philippines to the occupation of Japan, Casey directed an impressive engineer effort that allowed MacArthur's Allied ground, air, and sea forces to win the war and secure the peace.

Casey started his career in the Army and Corps of Engineers as an underage plebe who entered the US Military Academy [USMA] during the summer of 1915. He was third in his class, which graduated in June 1918 due to the demands of World War I, and joined the Corps of Engineers. He completed the Engineer School in June 1920 and had the normal troop assignments and company commands in the United States and with the American Forces in Germany before serving a stint as an engineer ROTC instructor at the University of Kansas from 1922 to 1926.

After completing the Company Officers Course at the Engineer School in June 1927, he received his initial civil works assignment with the Pittsburgh District. There he conducted one of the first major flood control surveys in the Corps of Engineers and later was responsible for construction at Deadman Island Lock and Dam (now called Dashields Lock and Dam) on the Ohio River.

The knowledge he gained at Pittsburgh was extremely useful in his next assignment as the assistant to the officer-in-charge, Rivers and Harbors Section, Office of the Chief of Engineers. As assistant to Colonel John J. Kingman, whose position was equivalent to today's director of civil works, Casey gained experience in dealing with Congress and the major leaders of the Corps on civil works. Not only was he involved in congressional matters; he also handled coordination with the districts and divisions, developed budgets and programs, and found time to design and patent a floating mooring bit for high-lift locks.

Casey was always known in the Corps for his ingenuity, intelligence, and skill as an engineer. In 1933 he won a two-year John R. Freeman fellowship from the American Society of Mechanical Engineers (ASME) to study hydraulics and civil engineering in Germany. His stay in Germany coincided with Adolf Hitler's consolidation of power, and he left there in 1935 with his Doctorate in Engineering and a foreboding of the European conflict that was to come.

When he returned to the United States in June 1935, Casey had orders to proceed to Vicksburg, Mississippi, to take over the Waterways Experiment Station. At the Quartermaster Dock in Bayonne, New Jersey, Lucius D. Clay, Casey's roommate for three years at West Point and close personal friend, gave him new orders—he was to be the chief of the Engineering Division at the Passamaquoddy Tidal Power Project headquartered at EastPort, Maine. This major New Deal public works project was soon terminated, but not before Casey made a significant, lasting contribution to the Corps' research and development laboratories. At Eastport, he established a concrete testing laboratory under Charles E. Wuerpel to examine the effects of saltwater, of extreme tidal ranges and accompanying variations in water pressure, and of the severe freeze-thaw cycles on aggregates, cements, and concretes to be used in the construction. That pioneering concrete testing lab still exists as the Structures Laboratory at the Waterways Experiment Station at Vicksburg, Mississippi.

Following the demise of the Passamaquoddy project, Casey served with the old Boston Engineer District on flood control surveys of the Connecticut River Valley before going to the Philippines in September 1937. His duty there was two-fold: He advised the Commonwealth Government on hydropower development and flood control and he served as engineer assistant to the military adviser, General Douglas MacArthur. To complete his first mission, Casey crisscrossed the Philippines to determine its potential for hydropower and its needs for flood control. For his pioneering endeavors in this area, President Ferdinand Marcos of the Philippines in 1972 bestowed on Casey the honorary title of "the father of water power development in the Philippines." The firsthand knowledge of the Philippine topography that Casey gained during his surveys allowed him during World War II to plan and act with a detailed personal knowledge of the terrain. His second duty, to advise MacArthur, brought Casey into close contact with his future commander and many of the Philippine Army engineers and units that worked under his direction in 1941-1942 and 1944-1945.

Casey returned to Washington, DC, late in 1940 to become chief of the Design and Engineering Section, Construction Division, Office of the Quartermaster General, under Brigadier General Brehon B. Somervell, another engineer officer. His primary concern was rationalizing and standardizing the designs for projects to be built as part of the nation's defense mobilization program. On the afternoon of Thursday, 17 July 1941, Somervell, who later commanded the Army Service Forces, gave Casey a new special project, the design of an office building to house the entire War Department. Over that weekend, Casey and his staff roughed out the design for a five-story, five-sided structure to accommodate 40,000 persons in what would be the largest office building in the world—now known as the Pentagon.

In September 1941, Douglas MacArthur, recalled to active duty as Commanding General, US Army Forces, Far East, in the Philippines, asked Casey to return as his chief engineer. Arriving back in Manila in October, Casey had little time to repair the years of neglect caused by minuscule defense appropriations before the Japanese struck Pearl Harbor on 7 December 1941. Air attacks and landings on Luzon soon followed, and the outnumbered American and Filipino defenders were forced to withdraw to the rugged Bataan Peninsula.

Casey's abilities as a soldier and engineer were most clearly seen in the early years of the war against Japan. During the arduous defensive fighting against the Japanese invaders in the Philippines from December 1941 until his evacuation with MacArthur to Australia in March 1942, Casey used his skill, intelligence, and imagination to provide the ill-equipped American and Filipino troops with the equipment and time to stall the enemy's advance. "Casey Cookies" became plentiful substitutes for precious hand grenades, while "Casey Coffins" made out of cigar boxes were used as antitank mines against Japanese vehicles. "Casey Dynamiters," mostly civilian mining engineers commissioned by Casey, destroyed bridges, supplies, and facilities in front of the advancing Japanese.

Casey's personal courage was as pronounced as his intelligence. He received the Distinguished Service Cross (DSC) in the Philippines and the Silver Star at Buna, New Guinea, in November 1942. Of all his wartime experiences, Casey's actions on Bataan stand out as his greatest mark as a soldier. He was constantly on the go, inspecting the frontline positions, advising units on improving their defenses, shuttling to Corregidor to see MacArthur and his staff, and providing what engineer supplies he could find or manufacture to strengthen the American-Filipino hold on the peninsula. He was the only member of MacArthur's staff who established his headquarters on Bataan and remained there rather than move to Malinta Tunnel on Corregidor. In fact, MacArthur personally had to order Casey to leave Bataan when President Franklin D. Roosevelt ordered MacArthur and his staff to Australia. Casey always regretted that he had left "his men" on Bataan and Corregidor and did not suffer their fate with them.

He went on to Australia, and there played a key role in establishing the base from which the Allied forces could strike back at the Japanese. As the chief engineer, General Headquarters, Allied Forces, Southwest Pacific Area (GHQ, SWPA), Casey eventually controlled an engineer force of over 275,000 officers and men by the war's end. He was fond of repeating MacArthur's comment that the war in the Southwest Pacific was an "Engineers' war. " (See "Toast to the Corps!" Appendix A.) It was an engineers' war because MacArthur's successes depended so heavily upon the seizure and development of air and ground bases that allowed the next forward movement. The task facing the engineers was no easy one because little or nothing in the way of military installations existed in this primitive area to support the Allied forces.

One of Casey's most significant contributions to the Corps of Engineers is *The Engineers of the Southwest Pacific, 1941-1945.* The seven volumes of this series that Casey personally conceived and guided through publication always had the same goal—to tell the engineers' story so that others would learn from their hard-won experiences. In the foreword to the first volume, Casey wrote: "The following pages record the contribution of our American and Allied Engineers in this great struggle. It is a proud record of hardship, sacrifice, and service. It is a magnificent record of magnificent men whom I am proud to salute. "

After the war, Casey remained with MacArthur as chief engineer of the US Army Forces, Far East, and Far East Command. He was responsible for developing the American bases in Japan, Korea, and Okinawa that supported the Army and Air Force presence in the Far East. His work with MacArthur during the occupation of Japan contributed to that nation's postwar recovery.

In 1948, when the successor for the retiring Chief of Engineers, Lieutenant General Raymond Wheeler, was being selected, Casey was the leading candidate. He was the choice of Wheeler; General Omar Bradley, the Army Chief of Staff; and Kenneth Royall, Secretary of the Army. President Harry S Truman favored Lewis Pick, the Missouri River division engineer. Although Casey was appointed the Ohio River division engineer in 1949, he never served in that capacity and retired in December of that year.

Casey went on to an active second career, serving in various posts with Schenley Industries from 1951 until his retirement in 1964. After years of chronic heart problems, he finally succumbed to a heart attack on 30 August 1981 while in the Veterans Administration Hospital at White River Junction, Vermont, recovering from a stroke suffered in July. He was buried at Arlington National Cemetery next to his son, Major Hugh Boyd Casey, who died in an air crash in Korea during the Korean War. In August 1982, Lieutenant General Joseph K. Bratton, the Chief of Engineers, and Mrs. Dorothy Casey, the general's widow, dedicated a new building at the Humphreys Engineer Center at Fort Belvoir, Virginia, in honor of Major General Hugh John Casey.

Career Summary

July 1918
Camp A. A. Humphreys, Virginia
July - August 1918
Student Officer, Engineer Officers Training Camp, Camp Lee, Virginia
August - September 1918
Instructor, Engineer Officers Training Camp, Camp A. A. Humphreys, Virginia
September - November 1918
Company Commander, 219th Engineers, Camp A. A. Humphreys, Virginia
November 1918- February 1919
Company Commander, 219th Engineers, Camp Dodge, Iowa
February - June 1919
Student Officer, Engineer School, Camp A. A. Humphreys, Virginia
June - September 1919
Tour of Observation, American Expeditionary Forces, France and Belgium
September 1919- June 1920
Student Officer, Engineer School, Camp A. A. Humphreys, Virginia
June - August 1920
Headquarters, American Forces in Germany, Koblenz, Germany
September 1920- May 1922
Commanding Officer, Engineer Barracks, Koblenz
Commanding Officer, Provisional Engineer Battalion, American Forces in Germany
Company Commander, 1st Engineers, American Forces in Germany
May - August 1922
Leave of Absence
Officer-in-Charge, Engineer Unit, Reserve Officers Training Corps (ROTC), University of Kansas, Lawrence, Kansas
June - October 1924
Member, Engineer Rifle Team, Fort DuPont, Delaware, and Camp Perry, Ohio
June - September 1925
Member, Engineer Rifle Team, Fort Dupont, Delaware, and Camp Perry, Ohio

September 1926- June 1927

Student Officer, Company Officers Course, Engineer School, Fort Humphreys, Virginia

Team Coach, Engineer Rifle Team and Pistol Teams, Fort DuPont, Delaware, and Camp Perry, Ohio

September 1927- June 1929

Military Assistant to the District Engineer, Pittsburgh, Pennsylvania

June - September 1929

Coach, Engineer Rifle Team, and Firing Member, Engineer Pistol Team, Fort DuPont, Delaware, and Camp Perry, Ohio

September 1929- June 1933

Assistant to Officer-in-Charge, Rivers and Harbors Section, Office of the Chief of Engineers, Washington, DC

June 1933- May 1935

Freeman Fellow, American Society of Mechanical Engineers, at Technische Hochschule and Prussische Versuchsanstalt fur Wasserbau und Schiffbau, Berlin, Germany (On Detail, Office of the Military Attache, US Embassy, Berlin)

June 1935- August 1936

Chief, Engineering Division, Passamaquoddy Tidal Power Project, Eastport Engineer Office, Eastport, Maine

September 1936- August 1937

Assistant and Executive Officer, Boston Engineer District, Boston, Massachusetts

September 1937- November 1940

Assistant to Military Adviser, Commonwealth Government, and Engineer Adviser, Commonwealth Government, Manila, Philippine Islands

December 1940- September 1941

Chief, Design and Engineering Section, Construction Division, Office of the Quartermaster General, Washington, DC

October 1941- March 1942

Chief Engineer, US Army Forces Far East (USAFFE), Philippine Islands

March 1942- July 1944

Chief Engineer, General Headquarters, Southwest Pacific Area (GHQ, SWPA), Australia and New Guinea

August 1944- February 1945

Commanding General, Army Service Command (ASCOM), Sixth US Army, New Guinea, and Leyte and Luzon, Philippine Islands

February 1945- July 1947
Chief Engineer, General Headquarters, SWPA, and US Army Forces, Pacific (AFPAC), Manila, Philippine Islands, and Tokyo, Japan
July 1947- July 1949
Chief Engineer, US Army Forces Far East (USAFFE) and Far East Command (FECOM), Tokyo, Japan
August - November 1949
US Delegate, 17th International Navigation Congress, Lisbon, Portugal
December 1949
Division Engineer, Ohio River, Cincinnati, Ohio
31 December 1949
Retirement from active duty, US Army
January 1950- February 1951
Executive Vice President, Pennsylvania Hospital, Philadelphia, Pennsylvania
February 1951- April 1953
Vice President and Assistant to the Chairman, Schenley Industries, Inc., New York, New York
April 1953- December 1954
First Vice President, Melrose Distillers, Inc., Schenley Industries, Inc., New York, New York
April 1953- June 1955
Chairman, New York City Transit Authority, New York, New York
December 1954-1965
Corporate Secretary and Assistant to the Chairman, Schenley Industries, Inc., New York, New York

Promotion History

Grade	Temporary	Permanent
Second Lieutenant	12 June 1918	12 June 1918
First Lieutenant	12 June 1918	27 November 1922
Captain	12 June 1918	1 May 1933
Major		1 February 1940
Lieutenant Colonel	8 April 1941	4 June 1942
Colonel	19 December 1941	
Brigadier General	25 January 1942	24 January 1948
Major General	20 February 1944	

Personal Data

Birth:	24 July 1898, Brooklyn, New York
Parents:	John J. and Margaret L. Casey
Wife:	Dorothy Ruth Miller, 22 May 1922
Children:	Two sons, Hugh Boyd and Keith Miles One daughter, Patricia A. (Casey) Clay

Inventions

Kingman-Casey Floating Mooring Bit for lockages through high-lift navigation locks. US Patent no. 1,997,586, dated 16 April 1935

Education

1910-1914 Manual Training High School, Brooklyn, New York
1914-1915 Brooklyn Polytechnic Institute, Brooklyn, New York
1915-1918 US Military Academy, West Point, New York
(Bachelor of Science, Distinguished Graduate)
1919-1920 Graduate Civil Engineering Course, US Engineer School, Camp Humphreys, Virginia
1926-1927 Company Officers Course, US Engineer School, Fort Humphreys, Virginia
1933-1935 Technische Hochschule, Berlin, Germany
(Doctor of Engineering)
1933- 1935 Research Program, Prussische Versuchsanstalt fur Wasserbau und Schiffbau, Berlin, Germany

Citations and Decorations

Distinguished Service Cross
Distinguished Service Medal, with Oak Leaf Cluster
Silver Star Medal
Bronze Star Medal
Legion of Merit
Presidential Unit Citations (4)
Campaign Stars (9)

Distinguished Marksman
Distinguished Pistol Shot
Philippines Distinguished Service Star, with Oak Leaf Cluster
Commander of the Order of the British Empire (Great Britain)
Grand Commander, Order of Orange-Nassau (Netherlands)
Officer, Legion of Honor (France)

Professional Societies

Fellow, American Society of Civil Engineers
Charter and Life Member, Society of American Military Engineers
Member, Permanent International Association of Navigation Congresses
Member, American Society of Corporate Secretaries
Member, Army and Navy Club, Washington, DC
Member, Army and Navy Country Club, Arlington, Virginia
Member, University Club, New York, New York
Member, Military Order of the World Wars
Honorary Member, Institution of Engineers, Australia
Honorary Member, Philippine Association of Civil Engineers
Honorary Member, Philippine Association of Electrical and Mechanical Engineers

Civic and Veterans Organizations

Chairman, Lay Advisory Board, Metropolitan Hospital, New York, NY
Member, Executive Committee of Mayor's Reception Committee, New York, NY
Vice Chairman, New York-Tokyo Sister City Affiliation
Consultant, Civil Engineering Group, Manhattan College, NY
Past Commander, Theodore Roosevelt, Jr., Post, American Legion, NY
Governor and Member of Executive Committee, United Services Organization, Inc., NY
Treasurer, Director, and Member of Executive Committee, United Services Organization of New York City
Trustee, Association of Graduates, US Military Academy

Engineer Memoirs

MAJOR GENERAL HUGH J. CASEY

US Army

This manuscript consists of edited transcripts of tape-recorded interviews conducted by Dr. John T. Greenwood, Chief of the Office of History, US Army Corps of Engineers, with Major General Hugh J. Casey in Bradford, Vermont, from 25 to 29 September 1979.

Major General Hugh J. Casey

Engineer Memoirs

MAJOR GENERAL HUGH J. CASEY

Childhood and West Point Years

Q: Could you tell me about your childhood in Brooklyn?

A: Well, there's not too much, I think, to say about that.

I went through the public schools and got through fairly fast. I was skipped four times, so I was graduated at the age of 11. Then from there I went to Manual Training High School and was graduated there at the age of 15. I won a New York State scholarship and entered Brooklyn Polytechnic Institute, taking civil engineering. I was there only during the freshman year, when I took a competitive examination for West Point given by Congressman Daniel J. Griffin, who was chairman of the Military Affairs Committee at that time. And out of 62 competitors I happened to come out first, so I got my appointment to West Point.

Q: What led you to be interested in engineering as a field of study?

A: Just instinct, not that I knew anybody particularly in the field. I just was interested in engineering and building and construction.

Q: What led you to be interested in seeking an appointment to West Point?

A: I had, of course, heard of Army and West Point, being in the New York area; and I was interested in Army football and interested in the military. We didn't have the war in prospect at that time, so it wasn't because of the influence of the war. But I just had a desire to go to the Point since late childhood.

Q: Do you recall anything specifically about what it was like to grow up in Brooklyn? Your friends?

A: Brooklyn at that time was unlike what it is now. We were living out in Bay Ridge, and just a short distance from our house we would go down to the woods and have picnics, play baseball, football, etcetera.

Of course, now where we lived is all developed and the houses are all close together. But it was a different league then from what it is now. I made many friends among the youngsters with whom I played.

Q: What did your father do for a living?

A: He was a plumbing and heating contractor. And quite busy and quite successful. Unfortunately, he died young, but he lived through my graduation from West Point. And I had three brothers and one sister. All three brothers went into law. After I won my appointment to West Point, I felt very thankful to Congressman Griffin, who had given me the appointment. He hadn't given it to me outright, as I had won it by competition. But after I got there, I was rather grateful and I used to send him football tickets, and I wrote to him frequently about my progress and so on. He was quite pleased about that compared to the appointments he had given previously to others from whom he had never heard anything more.

When my brother Martin wanted to go to West Point, I don't think he could have won an appointment in the competitive exam. He wasn't overly brilliant academically. In fact, he had started in public school a year ahead of me, and I had finished a year ahead of him. But Congressman Griffin, I think, was so pleased at the way I had reacted to his appointment that he appointed him directly, so that Martin also went to West Point.

Q: Now how long did he stay in the Army?

A: He served 11 years in the cavalry and coast artillery. But he was subject to terrific migraine headaches, and when he was on duty down in the Canal Zone the migraine headaches became very severe. He was sent to Walter Reed and then to a hospital out on the West Coast, but apparently they couldn't do anything for him and he was retired for physical disability. After his retirement he took a law course out on the coast and went into law and other related activities and was very, very successful as a lawyer and in general business.

Q: Could you tell me a little bit about your family background as far as when they may have come to this country?

A: On my father's side, his grandparents had come from Ireland and England. His grandfather served in the Civil War on the Union side and was killed at Shiloh. On my mother's side, her parents came over from Ireland and then settled in Pennsylvania.

Q: What was West Point like during the summer of 1915?

A: Of course it was small compared to what it is now. Our class was small [137 graduates]; the Corps of Cadets was small. Everybody got to know almost everyone else, unlike today when you have an entering class alone of almost a thousand.

So we were a tightly knit group. I felt the spirit among the cadets was excellent. I think everybody was pulling toward a common purpose. There were a few incidents that happened that you might be interested in.

Actually, I went in under age. You were supposed to be 17 when you entered West Point, and I was only 16. My birthday was July 24. So I would not be 17 until July 24, whereas we entered on June 15. My congressman was chairman of the Military Affairs Committee, and I naturally thought he knew what it was all about. He said, "You have to have another birthday before June 15." So I said, "Well, my brother's birthday is on June 7." He said, "All right, that's your birthday." So I'm one of those who went in illegally, you might say. Actually it would have been possible for me to have gone in with my correct age, and the only thing would be I wouldn't get the $40 or $50 a month, which was all you got during that period; then I'd be eligible for the payment at the correct date.

But anyway, I entered with my birthday supposedly as of June 7. Now oddly enough, later on when my brother Martin got his appointment to West

Point, we had two Caseys on the Army list just exactly one year apart. Our family was really clicking.

Q: Who were your best friends during your plebe year?

A: My best friend was Lucius Clay, my roommate and classmate. We first of all went into "Beast Barracks" and they put us through the maneuvers of drawing equipment and whatnot. We were lined up according to height because they were grouping the cadet companies by height. I was in the file immediately behind him. He was in front and I was in back—he turned around, looked at me, and said, "How about being my roommate?" So I said, "Fine." So we became roommates and deep friends from then on. That gave me an opportunity to know him very intimately. And we remained roommates all the way through graduation.

I might bring out one little incident about Lucius. He wasn't too hot in the field of discipline and he was getting many demerits. Once he thought it was because the tactical officer who gave him many of his demerits was very much interested in a girl that Lucius also was interested in. And he sort of felt that this tactical officer was giving him more demerits than he should have.

In any case, it was toward the end of our first-class year, approaching graduation, and Lucius had only about, oh, I don't know, about eight or ten demerits still to go. If you ran over this upper limit, that would mean you'd be deficient in conduct. And if you're deficient in any one subject, including conduct, you're turned back to the next class or discharged.

Well, we were very concerned about what to do, so I decided that I'd be the room orderly for the rest of the period, for several months prior to graduation, so that when we had our daily tactical room inspection and they found anything wrong, I'd get the demerits instead of Lucius. That happened over about two months, and I got the demerits. The week before graduation I got a charge for 'failing to change my name as room orderly" on such-and-such an inspection. In other words, the tactical officer was letting me know that even though I had been doing this and taking the demerits, he wanted us to know that he had been observing this all the time and stuck me with a couple of extra demerits just for it. In any case, Lucius was graduated.

Up at the Point I was relatively young and light, but I nevertheless tried to go out for athletics. I tried out for basketball, track, football, and wrestling. I did get on the football squad and the team, but I weighed only about 158. As I say, I was just a kid compared to the others. But I still made the squad and was playing halfback. As halfback, I was substitute for Elmer Q. Oliphant. I don't know whether you've heard of him, but Elmer Q. Oliphant was an All-American. He had been All-American at Purdue University and was graduated from there with a degree in civil engineering, a bachelor of science in civil engineering. He then entered West Point in the class ahead of ours but flunked out in plebe math his first year. This indicates, possibly, how some civilian schools handle their football athletes, whereas at West Point you had to meet rigid academic standards. So he was turned back to our class and was assigned to a room just across the hall from me. I was rather good in math and other subjects, so it was my job to help Ollie to try to keep him proficient. This wasn't anything improper, like disclosing what the exams were or anything like that. It was actually tutoring and trying to get him to concentrate on math and other subjects.

I was also substitute for him on the football squad. As long as Ollie was proficient academically, he could play and that meant I was a sub. And if he were not proficient in his studies, then of course he would not be eligible to play and maybe I'd be on the first team. Well, I figured it was much better to have Army win the football games than to hold back on his tutoring, so we kept Oliphant proficient all the time.

During the games, anytime that it was my turn to go in as substitute for Ollie, as he came out and I went in there was a tremendous applause from all those in the stadium. Of course, it wasn't because of my entering the game, but naturally applause for Ollie, for his outstanding performance; but it was nice to hear an ovation as I entered each game.

After my yearling year I was selected to be a cadet corporal, in fact the ranking cadet corporal in the company. This meant that the next year possibly, if everything went well, I would be the cadet captain or other high-ranking cadet officer. I was also in the choir. In 1917, after the outbreak of World War I, the choir was invited down to New York to give three concerts. Travel then was by train. And on the way down there were three other classmates with me who decided, well, maybe our voices wouldn't be missed in the recitals, so we decided it might be a good idea to enjoy the night on the town. So [George B.] Aigeltinger, [Roland] Stenzel, [Jacob G.] Sucher, and I, when the cadet choir debarked, instead of going with them, we ducked off. Then the next afternoon-this was on a weekend, a Saturday and a Sunday—at six o'clock we showed up at the station for formation and of course back to the Point.

We had thought they wouldn't be calling roll calls, when we were all down there only to sing. But they did have roll calls and we had missed three formations. So we were 'skinned" and had to answer the delinquency reports, and of course all I could do was say the report's correct.

As a result, I was 'busted" from cadet corporal to cadet private; given 66 punishment tours and a flock of demerits, and three months' confinement, which meant that you could not go to dances or other activities outside of your regular academic schedule but [were] restricted to your room through otherwise free time. So as a result, I was not made a cadet officer when the promotions came due. But to make it even worse, this happened shortly before June 1917, and that was the time we normally would have had our summer furloughs authorized at the end of two academic years. But because of the war, it had been decided that our class was not going to get its furlough, but continue on, studying on a compressed schedule.

Well, one morning at reveille, the adjutant rose and announced, "with the exception of cadets [Francis J.] Achatz, Aigeltinger, Stenzel, Sucher, and Casey, furlough is granted to the second class effective after breakfast. " So we were going to lose furlough as well. However, about three or four days later they apparently relented and they let us off on furlough; but when we got back we had to go into our three months restricted confinement and finish up our 66 punishment tours. Naturally I was not later made a cadet lieutenant or a cadet captain, and in fact it wasn't until shortly before graduation that they made me a cadet sergeant.

Q: How did you do in your football career?

A: As I said, I was much too young and much too light. I did pretty well in the few games in which I played; I mean, I was able to make some good yardage and so on, but I naturally never approached anything like becoming an All-American. But we did win.

Q: Do you remember, or did you get to know, any of the members of the class of 1916?

A: Yes. We particularly knew those who were on the beast barracks detail. New cadets spent the first three or four weeks in beast barracks before being sent to summer camp with the rest of the corps. In beast barracks they assigned some of the senior class and also a few of the junior members of the previous graduated class. Among those I knew, there was Notley DuHamel, Bill Coffin, Dick Worsham, and several others whose names I can't recall.

But we did know, of course, the class of ' 16 throughout our plebe year. The class of ' 15 had graduated as we entered. The class of ' 17 was graduated in April '17, shortly after the outbreak of the war. And then our class was graduated a year early in June '18.

Q: There wasn't much opportunity then for a plebe to get to know any of the upperclassmen?

A: No, you had no opportunity to know the upperclassmen at that time as there was no recognition between the upper classes and the plebes. The plebe treatment was moderately severe, I think, compared to what it later got to be. For instance, if something went wrong, you'd have to run up and down the three flights of the barracks with some upperclassman barking at you on each landing to have you run up faster, double time. Sometimes they'd give you a laundry bag full of laundry, carrying that running up and down. And then they'd have you stand up and brace for a long period; treatment was fairly rough but never physical.

Q: Do you believe that the move toward a more moderate policy, away from the kind of hazing you received, is wise?

A: Well, it probably doesn't do any harm. However, I think that those cadets who really wanted to see it through could easily stand the punishment that you got in the hazing. I mean, it was rough but it wasn't anything that approached being unbearable. I think that some reasonable change in it is proper, but I hate to see too much of a reduction from the standards that were there when we were there.

For instance, we were not permitted to smoke, we were not permitted to have any money. You didn't have a Christmas leave until the second Christmas you were there. You had no weekend passes. YOU were not permitted, of course, to have a car; you were not even permitted to ride on the post in a car. So if you had escorted somebody to a hop, you'd have to leave her at the hotel, walking there and back.

One time, after we came back from furlough, I thought I had turned in all the money that I had, what little I had, and yet there was one little dime left which I left on the locker shelf. Somehow or other the tactical officer saw it and I was "skinned" for having "money in my possession, " just this one dime that was left over. As I said, we were not allowed any money, so as a result, if you had a date up there, you couldn't take her down and buy ice cream, candy, or other things for her. She had to get the refreshments or whatnot and entertain you at the hotel. So it was sort of a "slug" on the dates who came up there, because they had to do the entertaining other than dances and athletic events. But they seemed to like it and always came back and there seemed to be a long waiting list of those who wanted to come.

Incidentally, speaking of cigarettes, I didn't smoke at that time, but Lucius Clay did. We were on the fourth floor as plebes. When the tactical officer came in for evening inspection, we'd hear a loud hock on the door down on the first floor. That was the signal for Lucius to stop smoking and get rid of the cigarette. We'd open the window and get a towel and try to shake the smoke away.

At that time young men used talcum powder after shaving, so we'd spread some talcum powder through the air to try to get rid of the cigarette smoke odor and get back and be studying by the time the tactical officer got up to our floor and to our room. One night our tactical officer came through but didn't say anything. But the next day, I think I was the room orderly, I was skinned for 'odor of cigarette smoke in the room at 8 P.M. inspection. " They were harsh on cigarette smoking and reported even traces of having done so.

Q: Do you remember particularly any of the tactical officers?

A: Well, we had Willie Wilbur, class of 1912. He was professor of athletics and was over in the gymnasium. We used to call him the "little boy tat, " as we thought he was overly military. His military posture and bearing were always perfect. The corps was small, so he would get to know the names of everybody there. He used to give particular attention to Mr. Casey and Mr. Clay, at least we thought so, because in different formations he'd holler to us about either standing up straight or getting your chest up higher, or chin in or something similar. But later we got to know him very well and all regarded him as an outstandingly fine officer. Later on he won the Medal of Honor over in Europe [North Africa] during World War II with an exceptionally fine record.

We did have another tactical officer, and he was sort of slow mentally. I remember one time they published an order which said the class would be divided into thirds. The first third would have riding at so and so, the second third would go to such and such at a certain time, the third third would go to something else at that time, and the fourth third would go elsewhere. He came up with an order about four thirds, with the first third from cadet A to so and so; then the second third from cadet G to so and so; etcetera. But he still showed four thirds.

Q: Do you remember who that was?

A: No, he was an infantry officer; he was not an engineer, of course. Oh, our Commandant of Cadets, everybody admired him. He was George Simonds, later a general officer-just Major Simonds then. He was just perfection and commanded everybody's respect.

Our superintendent had been [Brigadier] General [Clarence P.] Townsley. He was the father of Clarence Townsley, who was one of our classmates. But after him, when the war broke, they called back to active duty a Colonel [Samuel E.] Tillman. He was very quiet and was called back from retirement, as a former professor of chemistry, to fill the slot.

We had on the instructors' staff Major [Cleveland C.] Gee. He was an engineer. He was soft spoken, very quiet, but he was a very fine instructor. For our French teacher we had Major Geoffrey Keyes--he was also football coach. At that time they didn't have officers who were assigned just as football coach, so the football coach was also one of the instructors. He was an instructor in French. He was a better football coach, I think, than he was a French professor, because he used to say-for instance, when telling us to go to the blackboard, instead of saying *"allez au...,"* he'd say, *"allez-vous au . . ."* He'd put the "vous" in. In other words, he was asking, "are you going, or will you be going, to the blackboard," instead of giving the instruction to go there, and yet he was a French instructor. During World War II he distinguished himself as an Army corps commander, rising to the rank of lieutenant general.

Our principal French instructor was Mr. Vautier, a true Frenchman. Not only was he head of the French Department, but he was also Master of the Sword, so he taught fencing as well as French. In addition to that, he was our dancing instructor. At that time plebes had to learn dancing, with cadets dancing with cadets. Sometimes you were the male, sometimes you were the female. But indicative of the personnel and the shortages of personnel, they had this Monsieur Vautier as head of the French department, master instructor of the sword, and also our dancing teacher.

We also had a wrestling coach, Tom Jenkins, who had been world heavyweight wrestling champion. Tom Jenkins had one eye that had a sort of, cast so that one eye would look forward and the other eye would look slantwise. He got that when he was wrestling with another world champion, Gotch. He used to tell us, referring to his eye injury, that "any guy what would put another guy's eye out ain't no gent." Tom Jenkins did not use perfect English, but everybody loved him. He was a great big rugged man. He was also teaching boxing. Sometimes he'd have the class of cadets lined up while he was going to demonstrate some punch or counter-punch. So he'd look over and someone would think he was looking at him when it was actually somebody elsewhere. So looking at someone with his slant eyes, he would say, "come forward," and because the person who was being directed thought he was looking at someone else, he didn't come out. Well, then he would have to say it again and by that time he felt a little peevish, so when he got the cadet to whom he was actually referring to come out, he was a little angry. So as a result, in giving him the normally mild instruction, why he would give it a little bit harder and somebody would get a harder instruction blow than he otherwise would have received.

Q: Do you remember specifically any of your engineering instructors?

A: I can see them though I can't recall them now. Though I recall that I was doing fairly well in academics. The first year I was tenth; but the next year

I was number four, and then the next year number two, and the first-class year I was number one in overall academics. I was graduated as a "distinguished graduate"—a designation applied to those who average 92 percent or more on all subjects throughout the entire course.

Q: What was the effect of the declaration of war in April 1917 upon the corps?

A: The entire corps was at lunch in the mess hall and the cadet adjutant, Matt Ridgway, rose and then read the statement that we were at war, whereupon there were rousing cheers. Everybody looked forward to early graduation, because we felt that before long we had to get out and get into it. As a result, and within weeks, they graduated the class of ' 17 on April 30. We all looked forward to getting out and into the war. Some of us put in sort of a mass request for early graduation or for leave to get out into the service because we visualized this as the one war we were ever going to see. We hadn't had one since the Spanish-American War, and this one, we were sure, was going to be the last war and the last opportunity we'd ever have. So we were all very, very anxious to get into it.

Of course, the authorities indicated that they'd decide when and how and what they should do for our entry into the war. They did release the class of' 17 within weeks and the class of '18 a year early, in August of' 17. Our class, which was due to graduate in June '19, was graduated June '18. In the interim they compressed our courses so that we did have both the scheduled second-class and first-class year courses. They pushed them up to a rather heavy intensive schedule covering those same subjects.

Q: Was there any slacking off in the disciplinary requirements to make up for the accelerated schedule?

A: No. As I previously indicated, we were concerned that Lucius Clay was facing possible failure in discipline in conduct so that I took over as room orderly to take his possible demerits, because we were afraid that if he did exceed his limit in number of demerits, he actually would be discharged or turned back into the next class. Whether or not they would have done that, I don't know, but he was faced with that.

One thing they did do, however, was to transfer a number of the instructors to active duty with the forces outside and brought in other instructors. I don't think that the new instructors were the same type as those whom they were relieving to go out into combat service. They were men possibly who they [the War Department] felt were best qualified for academic instruction rather than combat activity.

Q: How much do you think that the acceleration may have either helped or harmed your education and career?

A: I don't think that it affected us too much, certainly our class. The two classes after us—the classes of '20 and '21 —were graduated on 1 November 1918. I think it definitely affected them, particularly the class of '21. I think that was recognized in that the '21 class—graduated on November 1, 1918, shortly before the Armistice—was then called back as second lieutenants to finish up a second academic year. So they had just two years, the last year of which was as second lieutenants instead of cadets. No, I think it did affect them, just having really one year of academic training before they were graduated. But then they were sent back, as I say, for the second year to partially make up for it.

Q: How much instruction did you receive in the type of combat that was going on in Europe?

A: I think there's a little misconception about education at West Point. I think the public thinks that here's a military school; you're sent up there to learn primarily about war and the military and whatnot. Now as a matter of fact, the great bulk of the courses are in math, English, physics, and subjects like those. There's relatively very little, percentagewise, of the whole academic course that evolves around war or combat. There are, of course, some military-type courses: ordnance and gunnery, military engineering, and military history. During the summer training periods you received primarily military instruction. Currently the cadets are sent to the various service schools for summer combat training including instruction in flying, too, which of course we didn't have when we were there.

But other than the practical exercises you get during the summer, and of course the drill you got otherwise in parades and going to mess and back in formation, combat training is really a relatively small part of the total. I think the academic objective was to give a good sound academic education in addition to basic military discipline and leadership. Based on observations later, I considered West Point's academic instruction superior to that of other civilian institutions. For instance, in 1922-26 I was on ROTC duty at the University of Kansas, with freshman to senior engineer classes. I'd be giving them examinations and I was astounded at the answers I'd get from college students. On one paper, for example, I think I had about 60-odd corrections just in spelling or grammar on a single page, and similarly on other pages. I felt that certainly, as far as KU was concerned, while their instruction may have included some specialized technical subjects, they didn't cover, I think, the subject as thoroughly or cover the basics to the extent that you had at West Point.

I think that anyone who went through West Point had a good foundation in math, in English, and basic academics or else he wouldn't have gotten through. I think in most of the civilian schools there's a lot of lectures with the students attending the lecture but without the requirement of performing every day. Up at West Point, in whatever subject it was—for instance in math— you performed every day. You went up to the blackboard, you had this problem and you put it on the blackboard and you had to go through it, explain and solve it, and you were rated on it. You were rated on each assignment each day. You had to perform. It wasn't a case of sitting back and listening to a lecture, or reading some text, and then at the end of the term taking an examination, and if you passed that exam, it was assumed that you had fully covered the subject.

I think the instruction at West Point, certainly when we were there, was very intensive. We had only ten students to each section, permitting virtually individual instruction. We had one instructor for each ten cadets, which of course is impossible in civilian universities where that amount of instructor or professorial talent could not be provided.

Q: I'll ask you now about some of your classmates at West Point–only in reference to what you remember of them at West Point, unless you want to take it further. The first one I want to ask you about is John Paul Dean, but with him we could probably take it up to the end of what you remember and what happened to him.

A: John Paul was a very brilliant student. He had been to Worcester Tech Worcester Polytechnic Institute], I believe, for three years before he came to West Point, so he had had most of the basic subjects that we had in our earl y years. He had covered math thoroughly and had had French and some of the other science courses. We had one course in mechanical drawing. I did extremely well in that because I could draw well, but John Paul wasn't at the top of the class in drawing. He didn't do nearly as well at that as he did in the other academic courses. He was the editor of our *Howitzer* and did an outstanding job at that. I was on the *Howitzer* staff with him, in charge of the biographies that we had for each of the class in the yearbook. Do you want to discuss his career later, too?

Q: If you want to at this point.

A: Later, of course, I got to know John Paul quite well. He was in the Corps of Engineers. In 1926 I succeeded him on his assignment in the Pittsburgh District on the Pittsburgh flood control survey project. He had initiated some of the studies, but I felt that they hadn't gone really as far as they might have gone, as there was yet nothing in the way of a report other than the field investigations on some of the flood control reservoirs that were under consideration. Upon his relief he was assigned to the Office of the Chief of Engineers.

In the Chief's Office he became a specialist in flood control, particularly on the Mississippi River flood control under Colonel Graves, Colonel Ernest "Pot" Graves, class of 1905, who had been retired for defective hearing and had also been an outstanding football line coach up at West Point and was in charge of the flood control studies. John Paul became the recognized specialist in this field and was very active in connection with the studies that we had on the Mississippi River and its flood control. He was in the Chief's Office during the period 1929-33, when I was on the Rivers and Harbors desk, where we got to know each other intimately.

Tragically, when World War II broke out, I think John Paul, who was more of a student and a research type than a military type, felt disappointed at not being selected, in spite of his brilliance, for some important military assignment. I assume it worked on him, and he committed suicide [at Louisville, Kentucky], a tragic loss of an outstandingly brilliant man.

Q: What about Pat Timothy?

A: Tim was quite a bright young chap. He graduated second in the class. He also had gone to college several years before he went to the Point. He was a French linguist and did exceedingly well in French, which of course gave him a lot of high academic credits in connection with our competition for relative class standing.

Tim did not engage in any athletics. He didn't try out for football or wrestling or other such sports. But I remember one thing about Tim. In the early gymnasium classes, one of the things we had to do was to grab a rope suspended vertically from the ceiling and pull yourself up several body lengths. Well, poor Pat Timothy was sort of rotund around the tummy and not very strong in his arms, and I can see him pulling on the rope and he just couldn't raise himself off the ground, let alone climb.

Tim was, of course, a very bright boy and, as I understand it, did very well during the war as chief engineer with Twelfth Army Group [General Omar N. Bradley]. When he retired in 1946, he went into business down in the Louisiana area. I believe he got some patents on some of his developments and was quite successful in either consulting engineering or with whatever firm it was that he was operating.

Q: How about Patrick Tansey?

A: Pat Tansey was a little dynamo. He was quite bright and very active. He did go in for wrestling and gymnastics and was very good at both. You know, aggressive and quick. He also was a member of the so-called *dirty dozen.* We had Hugh Murrill, who was our cadet adjutant, and there were some of the others who were on the upper levels of the cadet staff. And some members of our class, including Lucius Clay—he was a member of the dirty dozen - Hans Kramer, Pat Tansey, and several others, somehow or other sort of felt that the cadet staff was exercising too much authority or acting like a group apart. They felt that we should get together against them, how I don't know. But I can see Pat Tansey getting up on a soapbox and orating very enthusiastically and dynamically on the subject. He was sort of the active leader of the so-called dirty dozen. I don't think that he had anything materially against the upper cadet staff; it was just his feeling that we shouldn't kowtow to those members of our class who were in the upper layer of cadet colonel and so on.

Pat, too, served most ably in World War II in the Operations Division of the War Department general staff. The Operations Division at that time reviewed projects in connection with allocating supplies to the different theaters and their requirements. We liked Pat because he felt that the Pacific Theater was actually carrying on a war all the time, in contrast to the European Theater, where with the exception of Africa they were mainly preparing for war with the planned invasion to the European continent. We had continuing great difficulties in getting supplies and equipment and whatnot, which were given to the European Theater under its higher priority. We felt that Pat was a little more sympathetic to our cause and would, when we had dire need, be helpful in seeing what he could do to see that we got some of the critical things that were needed. Pat Tansey later came out to the Pacific and served under me and did well.

Q: How about A. G. Matthews?

A: Mattie was an odd combination. He was quite brilliant and very, very active. He was very military as a cadet and became a ranking cadet officer. He was one of the group that Pat Tansey thought were the upper layer opposed by the dirty dozen group.

Mattie served under me out in the Pacific and rendered outstandingly fine service. He was one of the first ones to come out to Australia after we had come down from Bataan. He was in command of the 46th Engineers, where he performed outstandingly on building air and port facilities, initially in the Queensland area and subsequently in New Guinea under great difficulties, with shortages of manpower, equipment, and supplies, using improvisations and personal drive. He was a real go-getter, going night and day in our early difficult days in New Guinea on airdrome and base development—all most vital for our requirements during that critical period.

Mattie was one who could accomplish great things and then, by saying this or saying that at the wrong time, could destroy much of what he had accomplished. For instance, the Air Force, of course, was always pushing for this and that, even while Mattie was turning out more than could physically be done. But the Air Force would still complain about something.

Whereupon Mattie might come out and in front of other Air Force officers say, "Well, that damn fool George Kenney, he doesn't know what the hell it's all about, " or something like that. And the same way about General [then Major General and later Lieutenant General Ennis C.] Whitehead, who was commanding general of the Fifth Air Force. Of course that would get back to Kenney and Whitehead, and they even demanded that he be relieved and sent home. I had to go up and fight for Mattie, for here he'd be doing wonders but occasionally saying something, sort of being quick tempered, particularly adverse to some of the senior Air Force boys, and they'd get irate and try to cashier him.

Mattie finally was relieved, returned to duty in the Chief's Office, and later he came out with some of the mapping group. Mattie was, in my opinion, extremely able. He could have been, I think, a major general. He never did get above colonel, possibly because of his quick temper when things went wrong.

Q: How about Leland Hewitt?

A: Hewie was bright but relatively quiet. Hewie got the assignment of air engineer with the Fifth Air Force, and then as chief engineer, Far East Air Forces, and worked closely with me and my headquarters. Unfortunately, the Air Force seemed to be primarily interested in getting their air personnel promoted and pushed on up, but they weren't equally interested in the other services who were serving with them, such as the engineers, signal, or the officers of other branches that were on duty with them. So as a result, Hewie, although he served outstandingly as engineer for the Fifth Air Force and Far East Air Forces, never got to be above a colonel. He performed extremely well, in my opinion, in the mission and the assignment that he had.

Q: Lewis Ross?

A: Tenney. I knew Tenney both as a cadet and later on quite intimately on the Engineer Rifle Team. He and I were both on the Engineer Rifle Team. He was coach of the team and later I succeeded him as coach. So I got to know Tenney quite well, not only then but later.

Tenney was on duty in Washington when the war broke, and after I came down from Bataan to Australia I received word from my wife that Tenney was anxious for field service, whereupon I requested his assignment with us. Initially I had him assigned as engineer with USASOS [US Army Services of Supply], the logistics command in our theater. Tenney did a very fine job there, even in the face of a severe physical disability with crippling arthritis, and was promoted to brigadier general. When we got on up to New Guinea, with the tropics and the problems that we had, I felt that the physical strain was getting too great on Tenney. In the terrible heat, he several times became overcome with heat exhaustion. I thought in the best interest of Tenney's health that he ought to be relieved and returned to the States, not because of any deficiency or anything that he failed to do, but in his own best interest. He was keenly disappointed. Tenney was a solid, extremely conscientious, and very able person who rendered a wonderful performance under very serious physical difficulties.

Q: How about James Newman?

A: I didn't know Jim as a cadet too well. He was a very likable person. After distinguished service with the Ninth Air Force in the European Theater, he became, I believe, engineer of the whole US Air Force. So that as a result I didn't have any particular contact with him in that respect, but I understand that he performed extremely well. I knew Jim socially and he and I were always very pleasant and had fun together, but I have no direct or intimate knowledge of his performance later on.

Q: Alexander Neilson?

A: Murray, as we called him, was a very able officer. He had a nice personality. My first real contact with him was when he was with the amphibian engineers. He came out with the 2d ESB [Engineer Special Brigade], commanded one of the regiments, the 532d Engineer Boat and Shore Regiment [EBSR] [from 29 January 1944 to 25 March 1945], and performed extremely well. I know on one engagement when one of their boats had been badly damaged, and even though there was heavy artillery and enemy fire, he went on out in his craft and rescued the personnel, even in the face of this heavy bombardment, for which he was awarded the Silver star.

He handled his regiment extremely well. The 2d ESB was the first amphibian unit to report out in our theater, under [Brigadier] General [William F.] Heavey. In the early landings they went in under great difficulties with only the small LCVPs [landing craft, vehicle and personnel]. Later on we got LCMs [landing craft, medium], the larger craft. But these small craft, I know on some of the early operations, would ferry our troops in, even under extremely heavy seas. In one operation with waves of 10 to 12 feet, they still made the landing. They lost a number of the boats, but they didn't lose any men, and made the landing very successfully.

They were a great help to us in our theater. We had difficulty with the Navy sometimes in trying to move our forces along the New Guinea coast. The waters were uncharted and the Navy didn't want to take their vessels up over uncharted waters. But we had the engineer amphibian brigade with light draft craft, and they were frequently in on such shore-to-shore operations and were of unbelievable help in making it possible to get troops forward from one place to another, landing on the beaches with no port or docks against a jungle and often against enemy troops. Murray performed very, very well on such duty. Later on, after the end of the war, Murray was sent up as engineer of XXIV Corps in Korea where he did very well, too, in that important occupation. Murray is one who should have gotten a promotion but, as I say, he was in the ESBs and we had only three brigadier generals authorized, one in command of each brigade, with only colonels authorized in the other elements of that command. But indicative of the type of personnel we had, one of the ESB lieutenant colonels whom we had became president of Gulf Oil after the war; I'm trying to think of his name. But all of our engineer special brigade personnel served extremely well, and Murray was one of the best.

Q: How about James C. Marshall?

A: Jim was a bright, sort of quiet individual. Of course, his big job, I guess, was when he was with Leslie Groves on the Manhattan Project in developing the atomic bomb. Later on he came out and served in our theater as G-4 with USASOS and performed very well.

Q: Lucius Clay?

A: Of course you have books written about Lucius Clay. Lucius had a likable personality. He had a great knowledge of history. He knew a lot about the Civil War, with his grandparents' homestead in Marietta, Georgia, having been destroyed during Sherman's march to the sea. At the time we entered West Point, it wasn't but 50 years after the Civil War. So when we went up to West Point, the memories of the Civil War were still fresh in the minds of those boys who came from the South. So there was still a strong feeling about the North and South, the Union and the Confederacy.

Lucius was one who knew what the Confederates had done under great difficulties, with lack of equipment, supplies, and so forth. They actually performed, I think, better than the Union forces did, considering their lack of supplies, equipment, and so on.

Lucius had a very good memory. He could read something, and it seemed to be photographed on his mind. As a result, in matters where memory was called for, they came to him relatively quickly and easily, such as in English, languages, and history. Lucius did have some difficulty in math, and particularly in descriptive geometry, the type of mathematics where you have projections of three dimensions, where you had to visualize that and put it on the blackboard. Also with differential and integral calculus. So I had to help him on math. Being his roommate I frequently had to explain or concentrate on the explanation of some of these more difficult mathematical problems.

But Lucius was very, very popular. He didn't get into athletics. I know he tried wrestling, but I remember I could out-wrestle him, which he sort of resented but he would try it again without success. He was popular, of course, with his classmates. In contrast to his later four-star rank, he ended up only as a cadet sergeant. He did not receive any high cadet rank. His disciplinary record of demerits was not of the highest, and at that time he didn't show any outstanding trait or ability to indicate that he was going to hit four-star rank and the top to the extent he did.

But he did have determination. He was strong-willed and very strongly opinionated. If you got into a discussion with him, his view was always the correct one. He'd persist and it was virtually impossible to try to change his views—his views were made up. I know later on sometimes he'd say, "Look Pat, I'm not going to argue with you anymore because you have your views and I have mine." And he'd call it off; he wouldn't want to continue trying to resolve a difference in opinion on some issue that came up. Either you accepted his views on it, or that was that. So later on as a commander, if he made up his mind in respect to something, why that was it, and he had the personality, force, and determination to push it through, and he wouldn't deviate or give up on it in the slightest. I think that was typified in the way he conducted his command up in Berlin, and in particular during the Berlin airlift and the way he was going to see that through. He would use every bit of energy that he had to see that that was accomplished.

He succeeded me in 1933 in Washington when I was in the Chief's Office as executive assistant in the Rivers and Harbors Section. This was a very responsible post because we had to do with reviewing the project studies and plans and specifications of all of the rivers and harbors projects throughout the country. These included also flood control and hydroelectric power projects. And answering correspondence to senators and congressmen. It was our function, really, to formulate such letters for the Chief's signature. If some issue came up, we wouldn't go in and ask General Brown [Major General Lytle Brown, Chief of Engineers 1929-1933] or General Pillsbury [Brigadier General George B. Pillsbury, Assistant Chief of Engineers] for the answers. But we would formulate what we thought proper, such as approval or disapproval or modification or substantive changes and so on. On complaints or queries from a congressman or senator we would get the report from the affected division engineer or district engineers and, based on that, we'd prepare the letters and replies.

So we'd formulate these letters for the signatures of General Lytle Brown, Chief, or General Pillsbury, Assistant Chief—and later on, in Lucius' case, General Markham [Major General Edward M. Markham, Chief of Engineers 1933-1937]. I think that assignment also gave one a good opportunity to meet many of the officers in the Corps because the division engineers and district engineers, knowing we were in that office, would frequently approach us even though they were much senior to us and say, "Now look, we need additional so and so, " or seek further support for their pending requests or projects. So we got to know a number of the officers in the Corps of Engineers. Also, and I think particularly in Lucius' case, it gave him added powers of presentation. He could dictate very fluently and very easily, and I think that the four years' duty there helped greatly in giving him the facility he had of presenting quickly and in proper terms and wording his views tersely and accurately. In contrast, if he had been out with troops, he would have had little of that. But being there in the office in a responsible executive position calling for dictation, analyzing plans, and analyzing topics of high importance, it gave him excellent training for his later major functions and responsibilities.

Q: How about Lloyd Mielenz?

A: Lloyd was a very nice, likable chap. It was unfortunate that he was caught on Bataan where he was at the surrender. He was in the Department Engineer's Office when I got out there in October '41. He served extremely well, handling their supplies and logistics functions, and as Colonel Stickney's [Colonel Henry Stickney, Engineer, Philippine Department] deputy or executive. Of course, later on when he was taken prisoner, that stopped his performance for the remainder of the war. But during the time that he was exec to Stickney, he did everything very, very well and, I am sure, would have distinguished himself under further opportunity.

Q: Samuel D. Sturgis?

A: You could write a book about Sam. I guess you know as much about him almost as I do. I knew Sam as a cadet, but not too well because he was in a different area and we just knew of him as a classmate.

The first opportunity I had really to know Sam was when he came up on the Passamaquoddy Tidal Power Project. We felt that Sam had sort of the junior assignment of the Corps officers who were up there. We had Major Philip B. Fleming, who was district engineer; I was in charge of the Engineering Division; Roy Lord [Royal B. Lord] had the Operations Division; Don Leehey the Administrative Division; Dan Note was executive officer; and then later on Sam came up to head the division that was to handle and operate the living facilities that were built for the personnel.

Of course, Eastport [Maine] didn't have much in the way of facilities, so as part of the project we had to build quarters for the personnel and officers and so on. And it was Sam's job to sort of direct the administrative functioning of those buildings and the personnel. This, we felt, in contrast with the major responsibilities that others had, was relatively minor. Everybody liked Sam because he always came up with a cute little joke or expression, but his responsibilities up at the Passamaquoddy project were relatively small, unlike the heavy responsibilities he so ably assumed later.

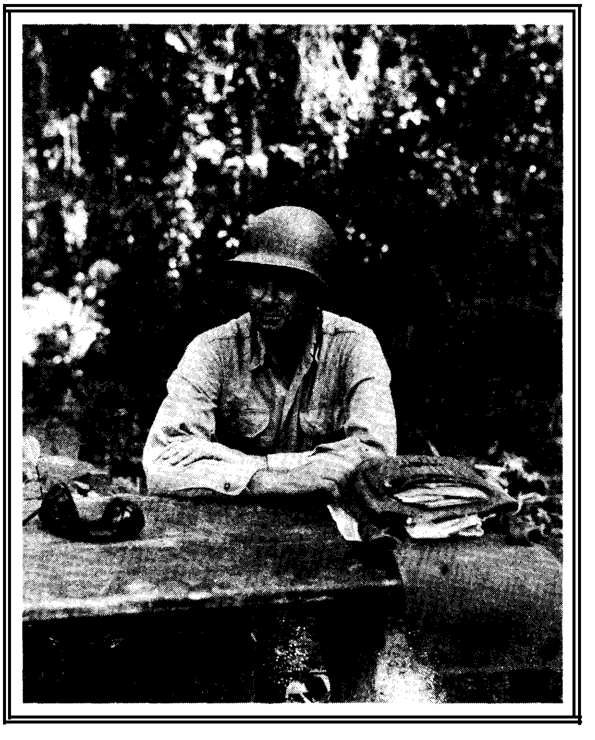
The next time I knew Sam was when he came out as engineer of Sixth Army. When he first came out with General Krueger [then Major General Walter Krueger] and his staff, the first reaction we had was that Krueger and his staff, who had been on the Louisiana maneuvers, had organized the staff and were preparing to conduct the war the way they did on the Louisiana maneuvers.

You should note that on the Louisiana maneuvers they had railroads, telephone lines, telegraph lines, maps, developed facilities, highways, and ready access to all forms of logistic support. We sensed that they did not have the grasp of just what the problems of our jungle warfare were—tropical heat, jungle conditions, malaria, uncharted territory, no readily available hardware store, no medical facilities, no water supply, no electricity, no railroads, vast intervening water approaches but no docks, no airdromes, etcetera. We sort of sensed that their viewpoint was mainly toward the tactical phase of sweeping ground operations.

But after we got Sam and the staff bedded down, Jack Sverdrup and I went down there several times at their request to give them talks on the problems that we had here—amphibious operations, landing beaches, jungle clearing, roads, building airdromes in each new objective area, supply, equipment and maintenance, aerial reconnaissance and mapping, shelter, water supply, and oil pipelines. But Sixth Army had a good approach toward their new and different responsibilities because the first operations were with small task forces, as on Goodenough Island and other small islands, and with unopposed landings. They set up their task force, occupied the area, built an airfield and pertinent facilities, and so on. But as I said, against no enemy opposition, whereby they were good training grounds for them to get started in the organization and conduct of task forces, carrying on the landings, supply and support of those units, and construction of the base and air facilities for major operations to be encountered later.

Of course, as we embarked into major operations they would set up larger task forces. It was the policy out in the Pacific Theater that the operations instructions would direct the task force commander, the combat commander, to conduct the whole operation. In addition to handling the tactical phase, it was his responsibility also to start and effect the main purpose of the operation, which was to go in and build an airdrome and related facilities.

We didn't have two separate commanders, like a tactical commander here and a separate engineer force to build the airdrome and related facilities. We made it the responsibility of the task force commander both to handle the combat phase and also to build the airdrome and do the various related things that had to be done. The reason we had for that was knowing that the task force commander controlled the priority on movement of equipment, materials, and supplies for the operation even though he didn't know a thing about building an airdrome. We, of course, did have the task force engineers with him. And fortunately, we had direct communication between my office; Engineer, Sixth Army (Sam); and the task force engineer.



Lieutenant General Samuel D. Sturgis, Jr. (then a colonel), Engineer, Sixth Arm y (1944).

Normally this communication is supposed to go through the commander and then through him down to the task force engineer, but it was sort of the tacit approval that prevailed throughout the command that I could give instructions on this or that, and communicate directly through technical channels to the task force engineer; or Sam, as engineer for Sixth Army. could communicate directly to the task force engineer, rather than having to go through the task force commander. This practice prevailed whether it was a major general who had a corps or division or lower commanders of a regiment or two. Anyway, it worked out very well, and Sam grew up with it and was extremely able in handling all of the problems and so on that he had. Sam had one characteristic-that irrespective of whatever operation it was or whatever he was engaged in, that at that time was the most important operation in the theater. I mean, he wanted to have first priority on materials, on manpower, etcetera. He'd appeal to you by telephone, we need or must have so and so, always trying to get priority of materials, equipment, of personnel, of staff and so and so to do the job. But he was probably the most conscientious person that you could find in working and following through on whatever projector operation or assignment on which he was working.

He was well admired and respected by the staff in Sixth Army, by General Krueger and by the staff, and so much so that he got their full support because they knew he was doing everything he could to get it done. And practically in all of the operations out in the Pacific, the one purpose in each one of these operations, all the way up, was to go in and develop an airdrome site and supporting base facility, each as a stepping stone to the next similar operation. In a lot of these operations the engineer complement was maybe half the force or even more than that because the main thing they had to do was go in, secure an area, and then develop it. Build docks, build oil pipelines and storage tanks, build roads, provide water supply, build the airdrome taxiways and dispersal areas, build a hospital or an aid station, whatever it was, provide for the storage facilities and so on to maintain this group. They knew that was the primary purpose of each operation because in that way you provided a base where you could get land-based fighter cover to protect the forward bombing and so on for the next operation.

General MacArthur's [General Douglas A. MacArthur] philosophy was "don't hit them where they are, hit them where they ain't. " In other words, if the Japanese were here, we wouldn't go in to attack them right from the front, have a glorious action and lots of casualties and take great claim for having overcome it. But we would land above them or below them, set up our bases there, and then let the enemy starve on the vine. They had either to work their way back through the jungle or try to get out by water. And in getting out they'd have to use submarines to take critical personnel out or use submarines to bring critical supplies in, and in doing it that way, why you were actually further aiding the war effort because you were diverting those submarines from damaging our critical supply mission by torpedoing the line of supply coming in by ships from the continent or from within the theater.

Q: How about Gene Caffey?

A: At West Point I didn't know Gene too well, other than as being a regular classmate, because he was a flanker and was quite tall and therefore in one of the flanker companies. Both Lucius Clay and I, who were medium height, were in the middle companies.

Gene was graduated into the Corps of Engineers. Subsequently they changed the system from promotion by branch that they had prior to World War I and shortly thereafter, and went into the single list, where everybody was listed according to the length of service irrespective of rank. As a result, for example, men in the infantry and cavalry who had three months, six months or more service than we, but still were second lieutenants and first lieutenants, were all of a sudden integrated up higher on the list than we. Gene sort of resented that and decided he'd go in and study law.

So he applied for a transfer to the JAG, Judge Advocate General Department, and he was sent to the University of Virginia and pursued a law course there and got to be commissioned in the JAG, passed the bar exam, and served in the JAG. However, when World War II broke out he decided that rather than be a desk soldier he wanted to get into action, so he transferred back to the Corps of Engineers and was assigned as engineer to the Amphibian Command [Engineer Amphibian Command—EAC]. He served over in the European Theater, so I have no direct knowledge of what Gene did over there. But I understand that he performed heroically; in fact, there is a monument on Omaha Beach to him, I think erected by the troops whom he commanded. I think you referred to some problems that he had where the commander felt that he was lax in not getting to where he was supposed to be. But they later found out that the ship that his personnel were on had been bombed and sunk and he had lost a good many of his men. But I'm sure that Gene, knowing him, would have performed to the maximum with what forces he had under any extreme conditions. And he wasn't afraid of combat or fire power and performed extremely well.

After the war, he transferred back to the JAG and later on became Judge Advocate General. Incidentally, he was father of the class baby. He had the first baby son of any of the graduates in our class, and as a result was awarded the silver cup that's awarded to the classmate who has the first son. The silver cup was made up of the silver napkin rings that each cadet had in those days. They were all turned in and made into the silver cup awarded to Gene. And not satisfied with his accomplishment in winning the silver cup, he kept on and I think he produced the rest of a baseball team to the extent, I think, of nine children. He was a grand guy.

Q: Now that we've covered your classmates in what became the class of June 1918, I would like to ask a few questions about people who were at West Point at that time and who later achieved some notoriety. Did you know Leslie Groves [Lieutenant General, US Army] at all when he was there?

A: Yes, I knew Leslie as a cadet. He was taller than I and so not in the same company. Leslie was a very good tennis player, even though he was a bit big and bulky. He had a far reach and he was not one who would exhaust himself running after the ball to hit it, but he did have a tremendous reach to get it and played very well.

I don't recall anything that particularly distinguished Leslie during the early years. The first intimate contact I had with him was when he was with General [Brehon B.] Somervell, who was called in to head up the Construction Division of the Quartermaster Corps. Leslie was in the Operations Division, and I was in the Engineering Division. I was in charge of the Engineering and Design Section in connection with the vast national defense construction program. This was in late 1940 to '41. I had to do with developing plans and specifications of standard structures like the igloos for Ordnance warehouse storage of bombs, the standard barracks that we used, the layouts of cantonments, the standard designs on the major ordnance plants and chemical plants to be constructed, virtually all of the things that were going into a vast military construction buildup preparatory to our getting into the war.

That had been under the Construction Division of the Quartermaster Corps, but they had sort of bogged down and Franklin Delano Roosevelt directed the Corps of Engineers to furnish the personnel to take it over. So Bill Somervell was put in charge and then he got other engineers like Delp [Wilhelm D.] Styer, executive officer; Ed Leavey, who had the Engineering Division; me heading up the Engineering and Design Section; and Leslie Groves in charge of Operations. The one in charge of Operations was supervising the field construction based on the designs and layouts that were sent out.

He was made a colonel early even though he was relatively junior. He wasn't one that was apologetic about it, but he had his rank and he utilized it. Leslie, of course, later on headed the Manhattan Project for the development of the atomic bomb, and I think he was an ideal man for that assignment. That didn't mean that he was the outstanding scientist or that he knew anything special about nuclear energy or the methods of producing the bomb, because they had these scientists who were doing all of that. But there was bickering among them. There were two possible courses to go in connection with developing it; and of course, if they pursued, say, both of them, you'd possibly be going on forever. But he was the one, I think, who would make the decision on the course to take and then be firm enough to see that they pursued that. He exercised firm executive direction and command, and he wasn't deterred by somebody who might know much more about it theoretically. I mean, that didn't change his views, and I think he was ably selected to handle the heavy responsibilities that they had, especially with the type of scientific personnel whom he was directing, so he deserves a great deal of credit for the accomplishments of the Manhattan Project.

Q: What about Leverett Yoder?

A: I didn't know Yoder as a cadet very well. He was an underclassman. But he did serve under me out in the Pacific. He was in command of a colored engineer labor battalion. The colored battalion at that time was just a source of labor. They had few officers, virtually no engineer equipment, and no specialized engineer construction training. They were regarded as a labor pool.

[Note: The Army in 1940 was a segregated institution; and, except for experiments in integrating officer candidate training and infantry platoons, it remained so throughout World War II. While many of the attitudes and expressions of contemporaries may seem out of place today, they reflect the times in which they were expressed.]

Q: The 96th Engineer Battalion is what he had?

A: Well, yes. It was just a separate battalion. I think they had four companies. They had very few white officers. They had very little in the way of equipment. All it was, really, was just a source of manpower.

In the early phase of the war we had relatively little in the form of engineer units. In Australia we had the 808th Engineer Aviation Battalion; we had the 43d and the 46th General Service Regiments, white; and then we had these two black labor battalions with limited officers and so on. So I put in a recommendation to the War Department that we be authorized to change their designation to general service regiments. We received that authority even though they were just black, untrained personnel with no special mechanical skills and no equipment and originally organized to provide a source of labor. But we got the authorization to make them general service regiments.

That authority permitted us to get more white officers and particularly to get equipment that went with general service regiments. All we had then was just this mass of manpower without skills and whatnot. Yoder had one of these units. He had the 96th, and we transformed it virtually overnight from a labor battalion to a so-called general service engineer regiment, which is supposed to handle engineer construction skills, all this heavy equipment and whatnot. Yoder did an outstanding job on that difficult assignment.

It was a very difficult job. A solid black untrained unit was a difficult unit to operate with. If they were integrated and trained, as they were later, you had a different situation.

For instance, I recall the 96th was one of the first units that was sent over to New Guinea. As I said, we made them into a general service regiment, got equipment for them, tried to train them to operate the equipment and maintain it, which of course was very difficult. We had them there working on airdromes, and they were doing very well. But if you had an air raid, why bing!, the unit dispersed, because I remember being there during an air raid and virtually all the unit disappeared. You'd find some of these men with perspiration all over their faces and some of them still trembling and shaking, and they'd run maybe a mile or more away from where this was, and we'd have to gather them up and get them back together. After some bombing experience and so on they got to where they could operate and perform, and as they gradually became better trained they performed well.

But Yoder, under extremely difficult conditions, handled those units very well. He later served with distinction as Engineer, I Corps.

Q: How about David Ogden?

A: Dave Ogden came out with the third of the engineer amphibian brigades [4th Engineer Special Brigade, ESB]. General Heavey had brought the first one out [2d ESB]; Hutchings brought the next [3d ESB]; and then Ogden brought the last one out. Strangely enough, after the war Heavey and Hutchings, who had been Ogden's seniors, were demoted back to colonel and Ogden kept his temporary rank of brigadier general.

He was regarded very highly, I think, by General Krueger and some of the others with whom he served. I know he did a very fine job, but I'd have rated them as engineer brigade commanders with Heavey as first, Hutchings as second, and Ogden as next. But Ogden was a quiet, firm, able officer. He ran a very, very fine command and performed very well under all the operations that they had.

I don't think he went in for dramatics, such as Heavey's brigade did, because they were the first ones there and had to go in, probably under the most extremely adverse conditions. The others later had greater support and greater materiel and forces for the operations in which they were engaged. But Ogden did very well and later on he served with distinction as engineer of the Korean Command, as commander of the Ryukyus Command and deputy governor of the Ryukyu Islands during their development as one of our important Pacific bases.

Q: How about Elmer Barnes? Do you recall him at all? He was over with Dinty Moore as one of his deputy commanders in Europe. I just thought you might recall the name.

A: I'm certain he wasn't with us. I knew Elmer Barnes as a cadet. Later I knew him socially in Washington when I was in the Chief's Office. He was on duty there. He was a very likable person, but I had no real experience or association with him on any military activity.

Q: William Wanamaker?

A: Wannie came out to the Pacific in the Transportation Department. Transportation was very, very important in our theater. I guess it is in every field, but particularly with us out in the Southwest Pacific. Here we were almost halfway around the world from our source of supply. To get equipment and materials, we had to get an allocation. Then from production you required transportation priority to get them to a port. You then had to have transportation priority to get them loaded and get them from the main port on the Pacific coast to a main port over in the Pacific. Furthermore, you could not have that ship come right up to the point where the supplies were needed. It had to unload at some big base. Then you had an internal problem of trying to get those supplies, again by water, from wherever they were landed to some other forward base; and then from there, you had to get them by small craft or by truck or whatever means you had to where they were needed. So that transportation was one of the key problems in connection with the conduct of the war effort in our theater. I think the problem was sort of overpowering and almost impossible to achieve. But I think Wannie did very, very well in improving and working on that almost impossible and difficult task.

Q: Charles Bathurst?

A: I knew Bathurst as a junior cadet up at the Point. He was tall and vigorous and able. He served as corps engineer with XI Corps and task force engineer on some of our operations and in them did very well. He was respected by all those with whom he had contact. I think he performed more ably than possibly he was given credit for. In some commands, you know, his being an engineer colonel wasn’t the same as though he were a colonel commanding one of the regiments in the task force. I don’t think he [got] adequate recognition from the task force commander that was his due. Otherwise he was capable of general rank. He was very able and performed extremely well.

Q: Do you know Claude Chorpening?

A: Chorpening? I know Claude, I knew him in 1940 in Washington when he served in the Chief's Office. He was a likable person. He served later in the European Theater.

Q: Here's another one that didn't serve in your theater-Frank O. Bowman?

A: I knew Frank quite well. I knew him at the Engineer School. He was junior to us. Frank was an aggressive little youngster. He was like some of those who were short in stature who try to make up for it in their attitude of always being ready to go. But Frank was very good. After distinguished service in the European and Mediterranean theaters, where he was promoted to brigadier general, he served as engineer of our Yokohama base. He was well liked and had an excellent reputation for performance.

Q: Orville Walsh?

A: Pinky Walsh. I had him on my staff at GHQ. And then when Sixth Army wanted some senior personnel, he served on Sam Sturgis' staff with Sixth Army. Later we organized engineer construction brigades to serve as the integrated engineer command with our major task forces.

We felt there was a need in the theater, with the engineer functions as important and responsible as they were, for some form of intermediate engineer command. Prior to that you had a corps and the corps engineer and his tiny staff. You had the division, but all you had in the division was the division engineers, the combat engineers, which unfortunately just before the war had been cut back from a regiment to a combat battalion.

I think that was one of the major mistakes that they made, this reorganization, because there was never a division that went into combat that could do it just with its combat battalion. They always had to attach another battalion, or sometimes two or three battalions, to handle the engineer load. Now I don't know whether this was a factor, but in World War I you had a number of engineers who were made general officers. They had been colonels commanding the division's engineer regiment in combat. When you had both combat regimental commanders and the engineer regimental commander, and if someone was transferred or lost as a casualty, and when one of the top colonels was the engineer, he was frequently called in to handle the brigade and ultimately maybe a division.

Now whether or not the line branches sort of resented having an engineer regimental commander with the same rank as their regiments and who was frequently promoted to general rank, they apparently decided they should make the engineer unit a battalion, with the engineer then merely a lieutenant colonel just commanding a battalion. However, he still had all the heavy engineer responsibilities of the division. In fact, in our theater the engineer responsibility within the division was much greater than that of the infantry regiments because you had these most important engineer tasks over and above combat.

At no time did you have the division in operations just with its own combat battalion, but you always had to give them another engineer battalion or more. Instead of a battalion, they'd have the equivalent of a regiment and a half or more to do the job.

Q: You were discussing your recollection of Pinky Walsh.

A: Oh yes, Pinky Walsh. So, as I say, when we set up these task forces you had to make up a new supervisory engineer headquarters and try to get an officer here and an officer there, give them these battalions, general service regiments, equipment companies, and construction units. You got a rather sizable engineer unit, but you had to form an engineer group headquarters to head it. So I recommended to the War Department for authority to set up a so-called Engineer Headquarters Command to head up an engineer construction brigade with a brigadier general heading it. We could then attach engineer general service regiments, engineer aviation battalions, engineer construction battalions, and [Navy] Seabee units, to this command as required for the specific operation. Thereby in the task force you had not just a newly assigned task force engineer group, but an engineer command with a commander who had this command and knew these units and so on to handle the engineer function. We organized these brigades, and we had Pinky Walsh as one of the first commanders of [5202d Engineer Construction Brigade]. We also had Bernard L. Robinson commanding one, the 5201st.

Pinky was sort of surprising. He was big and inclined to be a little fat, and he had soft skin, red hair, big brown eyes, and he looked like somebody who was soft in character and quiet and easygoing. But he had a keen, quick brain which seemed so different from his normal personality and conduct. You sort of pictured him as a slower moving person, but in a quiet way he was a very effective commander. I think he could analyze a problem very well and could see it through. He was held in high respect by all those with whom he served, including Sam Sturgis, General Sverdrup, and others.

Q: Going to some of the people who graduated in 1917, now we have mentioned previously Ed Leavey.

A: Leavey. Ed was a brilliant, very conscientious person. I didn't know him particularly well as a cadet, as he was in the class ahead of us. But he was assigned to the Engineer School as a student at the time that 1, too, was there. In fact, his quarters were right next to ours.

Ed was very ambitious, and one thing he wanted to do was to be number one in the class. We had groups who would get together frequently for drinks or dances or whatnot; but Ed sort of withdrew from that and would spend much more time, I think, doing nightwork and homework and studying and so on, to the extent of his ability on these studies.

It just so happened that, though I was sort of playing around a little bit more, when it ended up I came out first and he was second, so he was a little disappointed at that. Later on he was head of the Engineering Division under Brehon Somervell. I served with him as I had the Engineering and Design Section, and we got along very well there.

During World War II he served in the European Theater for several years and then as G-4 of the Central Pacific Theater. After the war in Europe was over, Bill Somervell's job was largely over. The remaining action was out in the Pacific, so a lot of Somervell's staff arranged for a transfer out to our Pacific Theater, including Delp Styer, who was a lieutenant general, and Ed Leavey joined him as his chief of staff. There they headed up our logistic command station in the Philippines.

But anyway, Delp Styer, Ed Leavey, I think [C. F.] Robinson, and Walter Wood, and some of the others came out and were assigned to take over what had been former USASOS, except it was called USAFWESPAC [US Army Forces, Western Pacific]. It was the American command that had to do with logistic support and was located in the Philippines.

So Ed came there on that assignment as chief of staff to General Styer. Very shortly afterwards the war terminated and then Ed, as chief of staff, was sent up to Baguio to receive the surrender of the main Japanese forces in the Philippines. Some of those who had served principally on tactical operations, in command or real combat operations against the enemy, sort of resented the fact that here Ed Leavey, who was a "foreigner" and had been out of, you might say, the combat activities in our theater during the war, was the one that accepted the surrender. Of course, it didn't make any difference to me, but some sort of felt that one of their own should have had that honor. Ed later became chief of the Transportation Corps, comptroller, and ultimately, a short time after retirement, president of International Telephone and Telegraph Company. He had a splendid record throughout.

Q: How about Bill Heavey?

A: Bill Heavey had been an instructor of mine at the Engineer School. He was an instructor in tactics, and a very fine instructor. I had known him just casually as a cadet at the Point. The next contact with Bill was when he came out as commanding general of the 2d Engineer Special Brigade. Nobody could have performed more ably, I think, than he did. The 2d ESB was well trained. When they first came out there was limited floating plant; they were just limited to the small LCVPs. But Bill on his own developed the so-called 'support battery" where we used some of these LCVPs and equipped them with racks of short-range missiles or rockets. A number of these craft would go in at the forefront of a landing, putting down a deadly bombardment of these rockets on the landing beaches, and were highly effective.

He did a number of things in connection with special training or special preparation of his unit. He worked very closely with me and my staff. He was always writing personal letters to me, always wanted some special assistance or other. We had direct communication, and through that relationship we ultimately expanded the authorization for the landing craft to include the LCMs, the larger landing craft.

At that time we had great difficulty getting landing craft to our theater, as they had to come out as deck load. When the transports came out, they had to take planes, they had to take engineer equipment, big shovels, big pile drivers and whatnot, so there was a very limited amount of deck space for special loading, which restricted the number of floating craft that we could get.

So we arranged with Washington to have them ship out the LCVPs in sections, I believe in 5-foot sections. We erected a boat assembly plant initially in Queensland in northern Australia, and later on we were able to move it over to New Guinea in Milne Bay.

We set up this boat assembly plant and brought in sections of craft that they could ship in the hold, and we'd get them and then weld them and assemble them into finished craft. That was the way we were able to get a major increase of our landing craft requirements.

Incidentally, later on when we were assembling the larger LCMs, we decided to get even greater capacity, so we got an extra section and instead of assembling just the sections to normal length, we had this extra section installed, and it not only gave us greater capacity but it actually increased the speed a knot-I guess by reason of the better configuration of length to beam in the hull.

But Bill and his outfit performed exceedingly well. I think you may have read his book, *Down Ramp!* While it does, as naturally would happen, sort of bring out a little bit more of his own personality or personal achievements in it, I think it covers it all very well. Our volume IV of *Engineers of the Southwest Pacific-Amphibian Engineer Operations* covers in quite a bit of detail, in addition to the overall, the excellent performance of the 2d ESB, for which Bill deserves a lot of credit as its commander.

Q: How about Daniel Note?

A: Dan Note is a little different from Bill Heavey. He had been commanding officer of the Engineer Amphibian Command back in the States where they set up the engineer amphibian [special brigade] units. And then later on he served with distinction in the European Theater. So I didn't have too much contact with Note, but I know from general talk that he performed extremely well in the development of this Engineer Amphibian Command and subsequently up to his ultimate assignment as Inspector General with rank of lieutenant general. Dan was one who was sort of quiet. He seemed to be not full of activity as compared to others but nonetheless a most able, though quiet, officer.

Q: John Steiner?

A: Jeff Steiner, at least that was his nickname. He had been a cadet ahead of me at West Point and served gallantly in World War I, winning the Distinguished Service Cross. He later resigned and then before World War 11 came back on active duty and joined the Engineer Amphibian Command. He came out as commander of one of the regiments [532d Engineer Boat and Shore Regiment from 1 October 1942 to 28 January 1944] in Bill Heavey's outfit and performed very well. I don 't recall anything special. He was very aggressive, active, dynamic, and a good regimental commander. He was later engineer of our X Corps.

Q: Willis Teale?

A: Willis Teale, also class of '17, I had known as a cadet. I admired him very much. As a cadet he won his letter in track, winning the championship, I think, in the 100-yard and 200-yard dashes. Very nice looking with a very nice personality. The next contact with him was when I came down from the Philippines. He was with the American command there in Australia. They were handling the logistics support to the American forces that were due to come on over there. He was chief engineer under Dwight Johns, who was chief of staff of USASOS. I felt that Willis Teale had slowed down somehow or other. He seemed to be a bit shy and, in talking to him, he sort of hesitated a bit. However, in a sort of quiet, undemonstrative way, he always got his job done, serving quietly but efficiently.

Q: How about several non-engineer graduates, like J. Lawton Collins?

A: I knew very little of J. Lawton Collins at West Point. The first real contact I had with him was when he was on duty over in Koblenz, Germany. I was then commanding Company A of the 1st Engineers and he' was with the infantry, but I don' t even remember what he was doing or much about him.

In other words, he had not attained any special prominence. He didn't play football. I was on the engineer football team. We used to play the infantry and the other branches. I was also on our engineer basketball team. We played the other units also in basketball and got to know many of the officers of the other branches. I later got to know both him and his wife. She was a daughter of our Chaplain [Colonel Edmund P.] Easterbrook. They were married in Koblenz, and we (Dorothy and 1) attended their wedding, and later we also were married in Koblenz and they attended our wedding. Of course, since we have been in constant communication, exchanging Christmas cards, etcetera, so we've kept in touch. He later on served with distinction early in the South Pacific Theater, commanding the 25th Division and later, as "Lightning Joe, " in command of VII Corps over in the European Theater. As you know, he later became Chief of Staff, US Army. I didn't have any chance to really serve closely with him, but we've been in touch over the years and I know of how splendidly he carried on throughout his service.

Q: How about Matt Ridgway?

A: I knew Matt Ridgway as a cadet, as he was the cadet adjutant. When World War I broke on April 6, 1917, he was the adjutant that announced to the Corps of Cadets that war had broken out and we had great cheering and whatnot. But I had no association at all with him after that. I had left Japan at the end of '49, and then Korea broke the next year. I was not involved in the Korean operation, but I do know that when General Walton H. Walker, our commander in Korea, died in a car accident, Matt Ridgway was selected to succeed him; and Matt, in the same very able way as he had performed in Europe, performed outstandingly in Korea. But as I say, I had no direct contact with him.

Q: Do you know Mark Clark at all?

A: I just knew him very casually as a cadet. We never served together. I can just recall him but do not recall him with any particular distinction. He wasn't active in athletics or such, and my viewpoint of him as of then compared to what he accomplished later was one of surprise that he had accomplished what apparently he did. His World War II record was an outstanding one.

Q: In the class of '16, did you have any contact with Wilhelm Styer?

A: Delp Styer? I knew him fairly well, though just casually as a cadet. Later on my contact with him was when he was executive officer to General [Brehon B.] Somervell at the time that Somervell was called in to take over the command of all the military construction in 1940 shortly prior to the war-a very responsible assignment.

Delp Styer was his executive, or chief of staff. Delp was sort of a quiet person. He'd listen attentively and soon and then give you his views of his action, but he worked very well as a team with Somervell. Brehon Somervell was sort of a real live wire and a go-getter, and Delp was sort of the quiet member of the machine, but he saw that things functioned and were fully coordinated. I was with them almost a year when I got this cable from General MacArthur to come back as chief engineer of the new command [US Army Forces, Far East-USAFFE] after he had been called back to active duty as its commanding general.

I remember at that time, incidentally, that Bill Somervell, when I got this wire, said, "Well, you're not going to accept that, are you?" I said, 'I definitely am. " He said, 'Why follow somebody who has been up and on the way out rather than staying with someone who is still on the way up?" I can still recall his saying that.

But anyway, I left, and later on I again saw Delp Styer when, as I previously told you, the war in Europe had terminated and he and top members of his staff came over to the Pacific and he headed up the supply command of our forces out in the Pacific with headquarters in Manila.

Q: Another West Point graduate of 1916 whom I know you did a lot of work with, Dwight Johns?

A: Dwight was cadet adjutant in 1915-16 when I was a plebe up at the Point. He was tall, thin, of fine military bearing, and was admired and respected by the corps. I don't think we served together after that until World War II. I don't recall that he had any contact with me when I was in the Chief's Office. When General MacArthur and selected members of his staff came down from Bataan and Corregidor to Australia, I was chief engineer of this new command of General Headquarters, Southwest Pacific Theater [GHQ, SWPA]. Dwight, who had been my senior in the class of' 16, was chief of staff of USASOS, a subordinate command under GHQ, which made it sort of a little touchy. I felt a little embarrassed about it. But he cooperated beautifully, both he and I, and we got along extremely well. He remained a brigadier general, but he performed very, very well both as the chief of staff of USASOS in Australia and later in command of the Service Command in New Guinea under trying and difficult conditions.

In New Guinea we were developing a number of airdromes and port and base facilities in the Moresby area in addition to airdromes and a major port and base facility at Milne Bay, down south. New Guinea was assuming greater responsibilities under a joint US-Australian command, and it was very important to coordinate the inter-Allied service activities. Dwight Johns was relieved of his command in Australia and was made the commanding general in charge of all the service activities in New Guinea.

There he had to deal with the Australians as well as the American forces because, particularly in the early part of the war, the only units that were in combat there were the Australian forces. The major US forces in New Guinea in the initial phase were the engineers and our Air Force. In fact, our engineers were the first ones of all the American forces to actually engage in combat when down at Milne Bay. A major force of Japanese made a landing there seeking to destroy our developing base and airfields. It is interesting to note that their farthest advance was halted where our engineers [43d Engineer General Service Regiment] had cleared an area for one of three runways. They hadn't built the drome yet, but that gave them a cleared field of fire and that was where our engineers and the Australians stopped the Japanese, who then withdrew saving this vital base from enemy capture. We were proud, too, that our engineers, not the infantry, were the first to engage the enemy in ground combat.

But anyway, in Moresby and in the overall New Guinea area, we had a very large engineer command. We also had the Australians, both combat and service, and it was very important to develop this base and related air facilities and to coordinate with the Air Force, through Kenney and

Whitehead, who would continuously make extreme and changing demands. So Johns had a very difficult task up there in connection with trying to coordinate the Australian requirements, they wanted this and that in connection with their operations, and with the American forces too, including keeping the Air Force satisfied. He did it extremely well as commanding general of the Allied Service Command in New Guinea.

Q: This brings up a question about command. When a graduate of West Point receives command of an organization and he has people from classes ahead of him under him, does this cause any kind of problem? You said you were uneasy at first about having Johns under you because he was in an earlier class at West Point.

A: Well, I think it depends on the individual. Some, you know, might resent it. During the war I had Stickney, Teale, Johns, Worsham, Earl Gesler, and others who had been senior serving under me. I even had General [Clarence L.] Sturdevant, class of ’08, who had been so much senior and my shooting partner when he captained the Engineer Rifle Team when we won the National Matches in 1924. He wasn’t directly under my command, but in 1944-45 he headed up the New Guinea Base Section of USASOS, and you might say we frequently had to give instructions to them.

But we had no problems. I don’t know what their attitude was. I’m sure the junior felt much happier—he was up on top. I think it’s more in how the seniors felt in a position where they were under a former junior, as to how they accepted it. I think a lot depended on how the one who had the senior command, how he acted and recognized the situation. In other words, if you’re just harpooning them or concentrating on them, you’ll build up a resentment. But my attitude was sort of sympathetic, and I would always be trying to help him get up, maybe to where he should be. Promotion is, of course, only one part of qualification, and when you get it and if you can’t handle it, you’re out. But with respect to promotion, opportunity is one important factor in connection with it. It depends largely on whether you’re in the right place at the right time.

Q: How about L. D. Worsham?

A: Worsham had previously been on the ALCAN Highway [Alaska-Canada Highway, now Alaska Highway], and that was a tough assignment. Then later on he came out to our theater toward the end of hostilities as chief engineer, AFWESPAC [Army Forces Western Pacific]. All of our construction work during the war had been done by engineer forces. We didn't do the way they did later in Korea and particularly in Viet Nam, for instance. You know that in Viet Nam they brought in civilian contractors with their special equipment and personnel and the contractors built this and that, but at terrific cost. But during our Southwest Pacific war, all of our engineer effort was done by engineer troops, a major engineer task. We used the Royal Australian Engineer [RAE] units, the work units that were with the Royal Australian Air Force [RAAF] the Navy Seabees [construction battalions], and in the rear areas in Australia we also used the Allied Works Council with the Australian government. They had personnel, usually senior personnel, who were not qualified to fight in combat, and they organized them into work corps units.

But after our recapture of the Philippines, we had Manila and other areas of the Philippines, all of which had been badly battered up, requiring reconstruction. In Manila the buildings were all battered down with artillery fire and so on, both by the Japanese and also by our forces in recapturing it. The utilities and bridges were all destroyed, so there was a major job in rebuilding. We also had Okinawa to be developed as an important Pacific postwar base, and there was a lot of reconstruction to be done there also. We decided that what we should do was to organize a regular Engineer Department division and district to release our engineer units for our contemplated invasion of Japan. So I wrote in and requested authorization, and the Chief set up an Engineer Department division. So they came out, we had conferences, and we set up the Western Ocean Division office in California, and we had the engineer districts in Okinawa, Manila, and Guam. Worsham was selected to be the division engineer. So I had frequent contacts with him in connection with the conduct of this reconstruction phase.

But it hadn't to do primarily with the combat phase of the war effort. It continued on, particularly after the end of hostilities when the war was all over. Then we were developing Okinawa as a major American postwar base and building more permanent-type construction rather than the type of work we had been doing where we wanted to get airdromes and base facilities hastily done for immediate operational needs and no construction for permanence.

So Worsham was the division engineer and performed very well. We did have many problems because it was toward the end of the war and the Philippines was in chaos. We made every effort to get Philippine labor and so on to work, but we had a major problem with Filipinos who were stealing supplies, transportation, and equipment. The contractors, too, had their problems getting the right type of US personnel to work over there. For example, on Okinawa there were no white lights [entertainment areas] or similar diversion, and some of the contractor personnel would take to drink, and they'd have to send many of them home. But Worsham carried on as division engineer and did very, very well on that.

Q: What about Bill Hoge?

A: I knew Bill up at West Point. He was on the football team and also, I think, on the baseball team. He was a talented and respected cadet, and everybody liked him. He was sort of quiet. The next contact I had with him was when he was an instructor at the US Army Engineer School when I was a student there with Ed Leavey and others. He was one of our instructors in tactics and some form of engineering, so we got to know him quite well. He was a major then. Everybody liked him. Of course, his principal subsequent gallant operations were over in the European Theater. I had no direct knowledge but heard a lot of what he had accomplished over there as an armored division commander and subsequently as a corps commander in Korea up to commanding general of the European Theater. He was highly respected by everybody in the Corps. We didn't know anybody who had any words against him for being overly aggressive or this or that. In his quiet, determined way, he performed very, very ably.

Q: Do you know anything about Stanley Scott?

A: Stan Scott was on our academy beast barracks detail. He would haze us and so on, so he was not one of our most beloved persons at that time, but he was doing his assigned job. I saw him up in Alaska one time postwar when I was ordered back to the States, and on my return flight I met him up there and had dinner with him. He was then commanding general of the US Army Forces there. But I had no service contact with him.

Q: Were there any other classmates or cadets at West Point during your time that you either got to know very well or that particularly impressed you?

A: Elmer Q. Oliphant, but we mentioned him, and Hugh Murrill.

Q: What kind of career did he subsequently have?

A: Hugh Murrill was cadet adjutant of the corps, and he was one whom Pat Tansey was working against because he was on the upper cadet layer. Hugh Murrill had been a graduate of VMI [Virginia Military Institute] and seemed like the tin soldier par excellence. He was very erect, tall, and handsome. He was also quarterback on the football team, but he sort of kept to himself. He was military from A to Z throughout, and I respected him highly. He did not remain in the service, so that later on when World War II came, he didn't get to higher rank, as he otherwise would have attained other than colonel in ETO Headquarters [European Theater of Operations].

We did have Ophie Knight, who was the ranking cadet major of the corps. He was the senior cadet officer of the whole Corps of Cadets. After some years' service in the infantry he resigned, as did his brother. But then when the war came, he came back onto active duty and later on was assigned out in the Pacific. He served as provost marshal on my staff at ASCOM (Army Service Command). This was the new command the GHQ setup to support the major operations for the invasion of Leyte and Luzon; I was detached as chief engineer in order to head this important command.

We used to have staff conferences in connection with preparation and coordination of plans as to what forces, landing craft, lighters, trucks, and supplies we'd need to handle our engineer requirements for the major construction effort, port and medical facilities, and the vast tonnages that had to come. Ophie was our provost marshal. Well, one day at lunch—we had been going at full pressure–and one day Colonel Wallender, my staff quartermaster, had just received his promotion to brigadier general. So we had this luncheon and served a few drinks with it, congratulating him on being promoted. During the discussion, somehow Ophie, who had been the heavyweight wrestling champion up at West Point as well as senior cadet officer, was talking about his accomplishments there and discussion got back to wrestling and his achievements. I said, "Oh, now Ophie, I was the middleweight wrestling champion. And I doubt you could throw me even now." The discussion went on like that with all the staff around, and here I was, the commanding general. Finally he had gotten so to where we just had to go to it. I said, "I'll grab you by your leg, by the thigh, I'll flip you up in the air and I'll drop you on the floor, putting my right shoulder blade into the pit of your stomach, and you won 't even know what happened."

Here was Ophie weighing about 225 pounds and there I was, about 155 pounds. So we shook hands and I made a quick dive and grabbed his thigh, picked him up, flipped him over on his back, with my right shoulder blade tip right in the pit of his stomach and knocked the breath out of him and there he lay. Well, we got a pillow and put it under him and left him there and then we went to lunch. That was Ophie Knight, who had been the senior cadet officer in the corps at the time we were there, and now my provost marshal. Nonetheless, he performed very well on his assignment.

Q: What was West Point like during World War I?

A: You mean while I was there during World War I? I don't know whether there was any special change in it other than an acceleration of everything including graduations. There was also an acceleration of academics. I think they were also trying to give a little more attention to combat training, but not at the expense of academics. They were also stressing French in place of Spanish.

I don't recall anything overly special, but occasionally you'd have some visiting French general or other commander come on up and give a lecture on the operations in Europe. The war hadn't gone on long enough, I guess, the time we were there for any senior American commanders to come back and talk about their experiences. But it was not the impact one might think that it would have. At first they were cutting our only furlough off completely, but then they even waived that; the class lost only about a week or so.

Q: So, except for the acceleration, it didn't really have much impact on West Point at all?

A: No, no.

Q: Was it your intention all along to be commissioned in the Corps of Engineers or had you selected that commission because of your standing in the class?

A: I had always wanted to get into the engineers. When I got my appointment to West Point, a reporter of the Brooklyn *Daily Eagle* came around and saw my mother. In my absence she gave him a picture of me and a glowing report on her son. It appeared in the Brooklyn *Daily Eagle,* among the other items, and it said, "Had Hugh John Casey been born one week later, he would not have been able to enter West Point." I was entering as the baby of the class.

Then it went on to say that I graduated number one in my class in high school and one in my class in elementary school. It also said number one in my class in Brooklyn Polytechnic when that wasn't so because you didn't even know where you stood there. It also stated that I now was going up to West Point and "graduate one in the class and go into the Corps of Engineers."

Well, when I got to West Point, there were at least a dozen yearlings who came around from different places with this clipping. They would always save clippings about youngsters who were going to West Point, especially if there was anything novel in them. Then they'd come back, giving me an hour or two to be able to recite this back from memory.

Lucius Clay, my roommate, would have to stand at attention, with his chin in, shoulders back, as they braced him, while I had to repeat this article. If I repeated that once, I repeated it several hundred times, with poor Lucius having to listen to it all the time while being braced by the upperclassmen.

But you were talking about my ambition for the engineers. As to this newspaper column, I wasn't there when Mother gave them this about my going into the Corps of Engineers, and I did not even know what one had to do to get into the Corps of Engineers.

Q: How was the Corps of Engineers looked at by the cadets? Was it looked at as a very favorable branch of the service?

A: Yes, it was. At that time they had promotion by branch of service. And in the engineers, I think some of the former graduates served for a while and then they had attractive offers in civilian activity, so that a lot of them didn't stay on for long periods of service, creating vacancies. Whereas in the infantry and other combat branches, most all stayed on for 30 years. They were in the military mainly to stay, whereas in the engineers they had opportunity for other jobs, so that there was a flow of personnel going on up. That was the reason that, for instance, when we were graduated, because of expansion of the Corps and many vacancies, while all the rest of the class were commissioned as second lieutenants in the infantry, cavalry, artillery, and so on, those of us who were graduated in the engineers became second lieutenants, permanent first lieutenants, and also temporary captains from the day of graduation. As it worked out I, at the age of 19, became a captain in the Corps of Engineers in World War I.

That was the reason those graduates who could make it would rather go into the Corps of Engineers-because of the advancement possibilities. As I say, during the war, unless one got some separate promotion, our classmates would see the engineers as captains, while the other classmates in other branches, with a rare exception who happened to get a temporary promotion, were serving as second lieutenants.

Of course, later on, after World War I, they changed the procedure for promotion by separate branch and adopted the single list for all branches. On the single list, they rated the seniority of everybody in company officer grade based solely on the date in which he had entered the service. So as a result, second lieutenants who had been second lieutenants throughout the war and who had gotten in prior to June 1918 would rank us on the single list for the rest of the time until promotion by selection was later authorized for higher grades. Though we still kept our temporary rank superiority, in subsequent pro-motion there were second and first lieutenants who had been under us becoming senior to us.

Q: Did the fact that the Corps of Engineers had this separate promotion by branch and tended to have higher grades than their classmates, or even of course higher than earlier class graduates of West Point, lead to any kind of problems? I know General Moore mentioned that there was a lot of jealousy involved and a lot of people didn't like the Corps of Engineers because they had the higher grades and had higher rank earlier.

A: Yes, there was a bit of jealousy. I don't think it was intense jealousy, but sort of a little resentment or envy as to why should these people here in this branch go on up, and over here somebody may feel that he's outstanding in his branch, and over there, let's say in the engineers, there's somebody who appears to them relatively mediocre and yet here he is up there. So apparently, as a result, they shifted the whole system and went into a single seniority list. Those of us who were in the engineers thought it was a little unfair in this respect, that when they put in the single list, they said that all those in company grade rank would be integrated by length of service but those who were majors or above would be integrated within their relative rank, by length of service. With those who were captains, first lieutenants, and second lieutenants, it didn't make any difference what their rank was; they were all listed just in the order of length of service seniority. Whereas the men above company grade were listed in the order of service seniority, but within their respective ranks. If they'd done that for the lower group, why then those who had been captains would have been on the captain list based on seniority and the first lieutenants would be on their list based on seniority, and then the second lieutenants. But the way it was, somebody down here who was a second lieutenant and had been in for a long time, who had gotten in early but never promoted, why he was up near the top of the company officer list. In the field officer grades they adjusted them by seniority, but within their respective field officer grade.

219th Engineer Regiment

Q: Upon your graduation from West Point, did you have any choice of assignment or were you compelled to take the assignment at the Engineer Officers Training School at Camp Lee?

A: No. All of the engineers in our class, I think, were sent down there initially as student officers, just for a couple of weeks. Then they selected some to be instructors, and I was among those initially so selected and stationed there.

That was during the summer, very shortly after graduation, when an order came out assigning about 38 or so officers to duty at West Point as instructors. These were not just from our class, but the whole list of officers who were being assigned to West Point to be instructors. Well, here the World War was on and if you were sent up there it meant you were going to be in the military academy for the duration of the war. Ed Leavey was also down at the Engineer Officers Training School, and he was an instructor along with me, and our names appeared on this list. So he and I went up to the Chief's Office to appeal for other active duty. We were the only two, I think, that got our orders changed, and he got to some outfit, and I got with the 19th Division with the 219th Engineers. So I got out of going to West Point while other people didn't.

Pat Timothy, for instance, went up to the Point as an instructor. And those who did were stuck up there for the duration of the war. But Ed and I, I think, were the only two on the list that got our orders changed. I got with the 19th Division, the 219th Engineers, and as a regular Army captain I was one of the senior officers of that regiment. It was commanded by Colonel Perley F. Walker, who was dean of the Engineering School at the University of Kansas. He had been an engineer reserve officer. Lieutenant Colonel Lunsford Oliver [USMA, 1913] and Major [Charles H.] Cunningham [USMA, 1916] were the other two West Pointers. We were the three regular officers of the Corps within the regiment.

I was commanding Company A of the 219th. We served there at Camp Humphreys for a while, and that was during the flu epidemic. We lost a number of men. Then we went out to Camp Dodge [Iowa] and joined the division in joint training activities in preparation to go overseas. In fact, we'd had our orders with an advance party at Hoboken [New Jersey] preparing for overseas movement when the war ended, so we didn't get overseas during the war.

Q: What was Camp Humphreys like in 1918?

A: It was not too well developed. When you were ordered to Camp Humphreys you went by rail and then you got on another dinky little railroad to Accotink and then from there to the camp. The camp just had temporary barracks, no special facilities. I think they did improvise or organize a little officers club. It was a good engineer training ground but nothing at all like what Camp Humphreys, now Fort Belvoir, is now. But it was a good training area for engineer operations. It was purely an engineer post. I believe Colonel [Virgil L.] Peterson was in command. I believe we also had Lieutenant Colonel Bud Miller, who had also been in the Engineer Officers Training School and later was engineer of the Occupation Forces in Koblenz, when I again served under him.

Q: Did you get to see Washington, DC, much?

A: Not then, no, I mean during this early period. Later on [1919-1920], when we were there at Belvoir at the Engineer School, we'd get in to Washington on weekends. But during the war it was an all-out effort. We were going around the clock.

I was then relatively young, and at the Engineer Officers Training School I had much older men who were there as students. They were reserve officers, those who had come in to active duty. I remember a Piper, who headed up the Piper Aircraft, he was one of my students, and somebody else who was a magnate down in South America and owned a tremendous ranch down there was one of my students. We had field officers, captains and so on, as students, but we got along very well.

Q: What was your major subject of instruction?

A: Well, most of these were graduate engineers, civil, mechanical, chemical engineers, and so on, so we didn't instruct them in their technical fields. One of the things we sort of concentrated on was physical training, to get them into physical shape. We had a lot of military engineer training, such as demolitions, the use of explosives, military bridging, and field fortification. As you know, World War I was a defensive war rather than one of movement, and so we gave instruction on construction of fortifications, trenches, and layout of field positions, and rifle marksmanship. But just the essentials, basic essentials of the military. No advanced engineering or subjects like that. They supposedly had that and you were preparing them for their first assignment with an engineer unit so they would know how to salute and get into physical shape and so on, with some knowledge of military administration and handling of a unit.

Q: Here's a question I should have asked earlier: What was your favorite area of engineering at West Point?

A: Well, I don't know that I had any special one. I'd say it probably was civil engineering. Civil engineering seemed to be the principal subject. You had courses in chemistry, physics, and intensive courses in advanced mathematics. You got more of the technical engineering later when you went to the Engineer School. At least the first Engineer School.

In the early pre-war days the engineers had their own separate Engineer School. They had it at Washington Barracks. Engineer officers, after they had a bit of service, were sent there for a two-year course and given concentrated courses in civil engineering, electrical engineering, mechanical engineering, river and harbor improvement. They had excellent laboratories, and they had very fine courses. Of course, there was no degree. Currently, the engineer graduates may go to the Engineer School to get refreshed on military engineering and courses like that but now get their advanced academic training in engineering mainly at civilian universities. They go to MIT [Massachusetts Institute of Technology] or Carnegie Tech or other such schools for some advanced courses in engineering and end up with a degree, usually a masters degree.

But at that time they weren't sending anyone to civilian institutions for higher education. You just did it at the Engineer School. During the war they were not operating the Engineer School to teach river and harbor development or similar courses. That was suspended and they had only the military activities going. When the war was over, they resumed the Engineer School, but instead of having it at Washington Barracks, which had been taken over by the General Staff, they set up the Engineer School at Fort Humphreys. It was a very fine Engineer School. They called in engineer officers, not just regular Corps of Engineers officers, but also other engineer officers, maybe some who had been dean of engineering or professor of engineering of some particular phase, as the instructors thereon the strictly technical engineering courses they were giving.

Engineer School

Q: After you left the 219th, you went to the Engineer School that had been established at Fort Humphreys until June 1919 and again September 1919 to June 1920. What kind of course were they offering? Was that primarily military or was that the reestablishment of the Engineer School?

A: That was the reestablishment of the Engineer School. They taught some military courses. They had courses in tactics and field and permanent fortifications, but mainly they taught engineering. They had river and harbor engineering, flood control, regulation of rivers, lock and dam construction. They had courses in mechanics and advanced mechanics. They had courses in mechanical engineering, electrical engineering, with fine laboratories with mechanical equipment, motors, generators, and so on. They had some mapping and some military, but a comparatively small part. That was to be taught mainly in the Company Officers course, which I pursued later, in 1926-27, where they had the military as well as other subjects.

Q: Do you think it was of value to you at that time?

A: Yes. I thought that the Engineer School training was excellent. Up at West Point you had courses in chemistry, electricity, physics, but they were basic, fundamental courses, which I think is ideal. I mean, you got a good solid foundation in the basic educational principles of mechanics, chemistry, physics, math, and so on. But this was sort of a second step beyond that in just getting into a book on electricity and chemistry or mechanical engineering or civil engineering. Here they'd get into the actual operation of major equipment, design of a bridge or other engineer structure, and so on.

Q: How would you compare the course that you took in 1919-1920 to the subsequent time you spent in Engineer School?

A: Well, they were quite different. I think the first course, the first one we took, was comparable to the postgraduate training that you now get in civilian institutions. But I think in some ways they tailored the Engineer School courses toward what you were going to do in the Corps of Engineers and specifically in civil works. They were better in being more adapted to the Corps of Engineers work than the specialized graduate instruction that you get now in civilian institutions. I mean, now when they go to, say, Carnegie Tech, they don't get a Corps of Engineers' training but they specialize in hydraulics or they may take something in mechanical engineering, but it's more an advanced engineering course in sort of a tight specific field rather than a general one. They won 't be getting mapping, river and harbor development, flood control; they won 't be getting certain other things that you would have if you were tailoring your course for Corps of Engineers preparational activities.

The company officers course which they had then was also very, very good and specifically directed toward Corps of Engineers activities. They did have a bit more military, including tactics and preparation of defensive positions. They went into river and harbor development, even though that was something that you think was more appropriately in the Engineer School that I attended the first time. But they brought that in, as well as military law and so on.

American Expeditionary Forces in Europe

Q: After you finished the Engineer School at Belvoir in 1919, you went to France for what was called the "tour of observation" with the American Expeditionary Forces until September of 1919, when you came back to Camp Humphreys. What was the purpose of this tour?

A: It was the War Department's idea to give an opportunity to those who had not served in Europe during World War I to see in the field what the actual situation had been. They'd take us over and they'd show us the depots that they had for the important Services of Supply, and up around the different field fortifications at the front, with some of those who had been involved going over the situation and talking about how the operation was conducted. This was poor preparation for the next war because in World War I they just dug in and that was it. When you think of the terrific loss of life, just fighting there, banging against each other, banging against each other with costly frontal attacks and with some tanks and few planes. With war of movement, somebody should have gone here or there and attempted a major flanking movement and settled the thing. No war could be conducted forever the way they conducted World War I in Europe. The French, having the Maginot Line later, which to them was to be an impenetrable defense line, thought falsely that was going to give them absolute security based on what had happened in World War I. Aerial bombing, heavy tank maneuvering, and outflanking movement by the German forces killed that dream in the early phase of World War II.

219th Engineers at Camp Dodge, Iowa

Q: You wanted to mention an incident at Camp Dodge?

A: Well, at Camp Dodge [Des Moines, Iowa], here I was with the 219th Engineers, you might say, the youngest officer of the command, but just by reason of being in the Corps of Engineers and the regular service, I had a comparatively high rank. Although I commanded a company, I was also the senior captain in our battalion. So when they had something to do with the battalion, I was the acting battalion commander.

The other battalion in the 219th was commanded by a Major Walton, I think E. C. Walton, who came from Texas. He was a very prominent consulting civil engineer. One day we were going to have a contest of bridging the Des Moines River. His battalion was going to bridge it, and we also were going to bridge it. We started off simultaneously. He started off upstream and they started building there. As it was a competition, I decided that the thing to do was to build from both sides of the river, because if you're building only from one side then you can progress only so fast. So I had my forces gather some timber and make some rafts. I got a cable across and set up a cable tower on the other side, providing a flying ferry. As we started constructing the bridge on the near shore, we also operated the flying ferry to take personnel and piling across to the other bank, thereby working from both ends.

Well, Major Walton looking at that, I guess, got terribly surprised and chagrined. They tried to work faster and faster, didn't get the piling in deep enough, and all of a sudden, wham! The forward end of their bridge collapsed; the personnel on it went into the water. We had to lower our cable so that as they came downstream they could hang onto it, and we rescued their personnel. We then kept on building and had our bridge finished far before they were able to resume and get theirs about a third through.

Perhaps young, less experienced leaders may, with imagination, excel and not be held down solely by the regulated procedures of more experienced personnel.

Engineer Inventiveness and Brigadier General Harley Ferguson

Q: Was it a distinctive characteristic of a lot of the engineers that you knew to be very inventive?

A: Not particularly. There were some who were, of course. But in the Corps of Engineers, most of your real technical experts in the various fields are in the Engineer Department civil service. The Corps of Engineers officers who were district engineers, division engineers, are-I' m generalizing, not talking specifics-are primarily engineer administrators and executives able to handle responsibility. In general, they have a technical background on all of this, but they're not immersed in the technical details.

Probably if they were immersed in the details of revetment, reinforced concrete design, or something connected with detailed design of a dam or generator, they'd be so engrossed in that particular phase that they wouldn't be qualified to handle the overall, such as dealing with contractors, dealing with specifications, supply problems, procurement problems, and coordination of it all. And so the district engineers and division engineers are mostly of an executive and administrative type-I mean if they're successful. You may find somebody like John Paul Dean, he was sort of a specialist in the field of hydraulics and flood control; and General Harley Ferguson, who was active on the Mississippi in connection with straightening out the channels through cutoffs.

Q: What about Harley Ferguson?

A: Ferguson. Harley Ferguson was sort of eccentric in that specific field. But by and large, I wouldn't say that Corps of Engineers officers were primarily inventive.

I might say, speaking of inventions, though, when I was on duty in the Chief's Office [1929-1933] I had Colonel [Edmund L.] Daley, and then later on I had Colonel John J. Kingman, as chief of the Rivers and Harbors Section, and I was their executive.

At that time we had these House Document 308 Surveys of all the rivers in the country; the Tennessee River, the Columbia River, and so on. It was a very active program. On the Tennessee, the Corps of Engineers were undertaking that development well before the TVA [Tennessee Valley Authority] took over. So we had plans for high-head dams, not just the low-head dams such as we had on the Ohio River primarily for navigation. But these large dams were joint projects for high-head development of power as well as navigation.

We needed to have navigation locks through them. Well, they had had some difficulty upon the St. Lawrence Waterway, where they had high-lift locks. At about that time somebody was drowned while he was in the little enclosed stairway area trying to transfer the lines where you secure the ship while it's in the lock. When the ship's in the lock, there are terrific surges of current both in the filling and also in the emptying, and they have to secure the vessel so it doesn't ram against the lock walls.

So Kingman said we were going to have a serious problem in the Tennessee Valley with the ships going through these high locks, and the problems they were having in securing the vessels. So I sort of said, "Well, I think I could work on it." So I sat down somewhere and after some cogitation, I thought about a floating mooring bit. At that time the mooring bits were fixed in the concrete walls at varying elevations and you had to transfer the lines as the ship went up and/or down during each lockage.

I devised a floating mooring bit mounted on a tank that would float up and down in recesses in the lock walls, with rollers or wheels for movement. These tanks would be recessed in the lock walls either with rollers or with wheels on a rail track. Then as you put the line on the bit, it would always remain at the same relative elevation as the ship. If the ship went down, why of course the floating mooring bit would go down with it, and if it went on up, it, too, would rise, and that would solve it.

About that time the Engineer Department had had a problem with some civilian engineer in the department's employ who had decided to sue the government for royalties for developing some form of revetment. So Colonel Kingman said we ought to protect the government and get a patent on this, because otherwise somebody may come along and do likewise.

This was shortly before I had gotten my Freeman fellowship, and I was leaving for Europe. So anyway, I prepared all these sketches and with detailed descriptions and left for Germany. Well, within a month or two Colonel Kingman had had the legal department prepare an application for a patent, with the perfected detailed drawings, and the claims for a patent to be issued to John J. Kingman and Hugh J. Casey. So we're nominally joint inventors of that, but his only contribution to it, other than processing the patent application, was "we're going to have a problem" and I worked on and solved that. Then when I left, he had the legal department and the others process it. I noticed later on in the literature—I think it was after General Kingman had died-they talked about him as the inventor of the Kingman mooring bit.

But you were taking about whether people in the Corps of Engineers and its upper personnel are inventive. With occasional exceptions, usually back in the early years, they were not. Of course, in the early years the only technical school we had in this country was West Point, and the earliest engineers were graduates of West Point. They were active in the construction of the railroads, opening up our rivers, developing our ports, lighthouses, dams and waterways, and so on. They had to develop the civilian employees, who originally received their training from the district engineers, who were members of the Corps of Engineers. But nowadays, with the great production of all kinds of engineers and specialist engineers, and the availability of them to go into the civil service, that creates a great reservoir of well-qualified technical personnel.

Incidentally, though, speaking of inventiveness, you may be interested in what I thought would be a major contribution to our war effort. This was in '42, I believe, when I was the chief engineer of GHQ, SWPA, and of course busily engaged on the construction of airdromes, among our other activities. Our war operational runways were not like the usual commercial ones with smooth wide concrete or macadam surfaces but had to be developed quickly of gravel, coral, landing mat. Our pilots, particularly in the early stages of the war, were not men of long years of flying experience, but generally comparatively young and far less experienced than commercial pilots. Our planes had high landing speeds.

In any case, I observed that on each flight landing, the tires were subjected to extremely high force in having to accelerate from zero to landing speed, also leaving streaks of rubber on the rough landing surface. The landings were further aggravated when it was not a perfect two- or three-point landing, due to the additional turning force resulting from a one-point landing tending to turn the plane during this vulnerable landing stage.

I figured that if the landing wheels were in rotation approaching landing speeds on landing, these adverse conditions could be avoided. I decided that if the tires were so cupped on their sides that when they were lowered for landing with the cups so mounted as to have their concave portion facing forward on the under side of each wheel and thereby having the convex sides facing forward on the top side, the strong wind forces acting on the wheels when lowered would gradually rotate the wheels to approach landing speed. I also indicated that alternatively and preferably similar cup arrangements could be mounted or built in the spoke sections of each landing wheel so that when the wheels were lowered prior to landing they would be accelerated by the wind to landing speeds.

I then prepared sketches of such devices and forwarded them through channels to the Chief of the Air Forces in Washington. About a month or two later I received a return endorsement turning down this suggestion on the grounds that "the Chief of Air Force had determined not to add other extraneous devices that would add to the weight of the plane. " I still have that communication somewhere in my old war files. I still feel that many tires would have been saved or their lives prolonged and certain landing accidents avoided had my suggestions been adopted.

District Engineer: Technician versus Manager

Q: General Moore, and also Lieutenant General Walter K. Wilson, who was later Chief of Engineers, in interviews with us have stressed the fact that an engineer officer who tried to concentrate on the technical aspects, who was a technician first and a manager second, would not have a successful career. They stressed that the district engineer who tried to solve the technical engineering problems and became an expert, as General Moore says, the expert engineer was bound to fail. He had to be a manager-administrator and realize that fact.

A: Yes, that's so. It's just as though, let's say, you were a commander who had been in the field artillery, and if he's commanding a division or corps and he's overly concerned with all the details of the field artillery while he has the infantry here, the engineers there, and supply and logistic problems, why, he's lost. He can't concentrate on his specialized field. It's his mission, his primary objective, to coordinate all this and get the best utilization of what resources he has and utilize them according to priorities and needs. So it's the same way in the Corps of Engineers where, in particular, you frequently get new and sudden different assignments.

All of a sudden somebody is assigned to be chief engineer of the Passamaquoddy Tidal Power Project. He knows little previously about creation of energy by tidal power, but here he's suddenly moved from here to there. He has to organize the thing, so he recruits some specialist personnel, somebody that's going to be in engineering, somebody that's going to be in operations, and they have to assemble a staff. You're going to have to set up a soils laboratory to make certain tests on foundations. You'd have to set up a hydraulic laboratory in connection with the best design of the turbines and tailrace under these varying head conditions plus further research and analysis of galvanic problems with salt water operation. In that connection, however, I did prepare and present papers on "Construction of Dams in Flowing Water" before the Permanent International Association of Navigation Congresses [PIANC] and a paper on cement for the Passamaquoddy project delivered to the Portland Cement Association.

However, if he concentrated solely on what he thought was the critical problem, why, the operation is going to fail. I mean, he has to get the personnel and the forces that are going to be qualified to handle all of the phases, whether it includes finance, it includes problems with contractors, it includes personnel and administration of the facilities that you need if the personnel are going to do the job.

That's particularly so in the engineers because he doesn't stay in a specific assignment area for life. He's maybe here three years, four years, transferred, then here he has an entirely new responsibility, a new area, and he has to utilize the forces here, organize the forces there for whatever this new problem or new situation calls for.

American Forces in Germany

Q: We were talking about your trip to Europe in 1919. Who else went with you to France?

A: Well, our class–I mean, our West Point engineer class—and all of the engineers in the class following ours. I guess about 50 or 60. I can't even remember who some of the personnel were that were in charge of it. I think it was Colonel Virgil Peterson [USMA, 1908]. I was trying to think of his name before as the commandant of the Engineer School. He was a tough commander.

I think Bud Miller also went along as one of the heads of it. They took us on a tour through the battlefields and also gave us lectures and so on about what you might say was the engineers' responsibility in the Service of Supply. This covered the depots that they built, the railroads, the problems on roads and maintenance of roads in combat, which was a very difficult problem with the heavy rains they had and so on. Of course, at that time they didn't have the heavy engineer equipment that we had during World War II and you just feel, in looking back, that it took them a long time to do relatively little, you know, compared to what was accomplished during World War H, with the equipment and forces that we had.

Q: Were there any important results on your career from that tour?

A: I would say none other than what might have happened. You know occidental Petroleum? You know that's on the big board, and who's the head of it?

Q: Armand Hammer?

A: Yes, Hammer. He later on had his art gallery and other manifold activity. Well, he was, if I remember correctly, if he was the same one. I don't know whether we had gotten to Paris or someplace on this tour when I came across him. He was under orders to go up into Poland and Russia on a relief expedition because they had a severe typhus epidemic. They were assembling a staff when I talked to him. I wasn't married at that time, so I thought this would be a wonderful adventure. So I volunteered to go along with him and their group.

So I contacted whoever was our engineer in charge, and he said no. I had to go back with our group to the States. But if I had joined him, my life might have been a different story. I don't know what would have happened later if I had been associated with him then. He saw that the people were all illiterate and therefore they were all going to need pencils, so he got a concession on making pencils and selling them there. At that time, a ruble was worth nothing, so he was going to take compensation in caviar, fur, and works of art. So he got those and set up his art gallery in New York. Then, of course, he later on got into petroleum, cattle breeding, and also into distilled spirits. He built up the Dant Distillery operation, which Schenley later bought. Everything he touched ended up in gold. Possibly if I had gone with him, maybe being an engineer or complementary to whatever the situation was, I might have ended up a millionaire of Occidental Petroleum or in some other phase of his later activities.

Q: What were your impressions of the American Expeditionary Forces in France when you were there?

A: Of course the war was over and they were going through the process of demobilization and sending the forces home. But as you looked back, there were some gallant actions performed by the various forces. But you wonder why they did it the way they did and why it couldn't have been done otherwise.

When we got into it, the war had been going on under British and French control, and so there was very little that this upstart American group could do. I man, they looked down on the Americans when they first came in. They figured they were untrained, they were inexperienced, and so on. And here they (our allies) had been fighting through the mud for years.

So the Americans didn't really have an opportunity to go in and upset the applecart and get into a new form of operations. They did approach it in connection with getting into a war of movement toward the end. But there was more effort expended and more lives lost on all sides in connection with the war as it was fought than the results that were accomplished.

At the end, you had the same situation as in World War II. It's a tragic thing when certain issues arise between two countries that cause them to engage in war; for their resolutions they go to war. Now either you win or you lose. If you lose, that's bad because the enemy can then enforce whatever they want on you. If you win, why then you're in the fortunate position to resolve whatever the issues were over which you went to war.

You had to resort to combat to resolve these conflicting issues. At the termination of hostilities, if you've won, it's the most important part of the whole damn war. But unfortunately in the United States we expend great effort and resources, separation of families, and loss of life; but the day that the war is over and we've won, we hoopla and hurrah as though that's the end. And yet that's the most important time for the resolution of whatever it was that got you into this conflict.

At that time our American public loses interest. We want Johnny home and we want Billy home and we want so and so; we want to cut down the armed forces; we want to get back to business as usual. And in the meantime, other opportunists are over there resolving these things in their favor at this most vital period. We did it in World War I and we did it in World War II. . And we'll do it in World War III if we get into one. Unfortunately, we just can't seem to learn from past experience as to the importance of the immediate postwar period.

Q: What was Paris like in 1919?

A: I don't have any real recollection of Paris. We were there such a short time. We knew that Paris was sort of an active place, they had the Follies Bergere and so and so; but we were there such a short time that we had no opportunity really to know this town or that town.

Q: What about the rest of France?

A: Well, the principal part that we saw was where they'd had devastation and bombing. We went up to the front lines where there had been extensive bombing and artillery fire damage. You did not have any of the physical destruction in the back areas that you had later on in World War II.

They had no terribly long-range artillery. They had no major bombing force. They didn't have the capacity to throw destruction all over the country in the rear of the battlelines. The battle destruction was mainly just along the front where they had been engaged in combat over a long time. The rest of the country was peaceful, other than being disrupted by having to apply their efforts primarily toward the conduct of the war. But the farms, the agriculture and so on, of course, they had to neglect as well as the improvement of utilities or roads or other things in the rear, but there was no material destruction compared to World War H.

When you went to Japan at the end of World War II, or to Europe, you saw overall destruction where there had been extensive bombing and heavy artillery and long-range artillery. In Japan, for example, instead of using heavy explosive power in our bombing, much of our destruction there was by the use of incendiary bombs. Japan was a prime target for that. They had vast communities with wooden houses and rice paper partitions and so on, so that if you dropped a lot of incendiary bombs, everything took fire.

So when we went in there later, the only thing you could see would be some clay tile roofs which had fallen in and just ashes here and there. There was an occasional. chimney, because very few houses had fireplaces and chimneys, but in those that had the chimneys could at least withstand fire, so they stood.

And the other thing you could see were safes. You could see a small safe, a medium safe, rusted and whatnot, here and there. Due to the earthquake and resultant fire that they had had in Yokohama in 1923, some enterprising safe salesman had gone around after that and said, "Now look, we're subject to earthquake and fire. You'd better buy our X2-3 safe. " So a lot of people had gotten safes. So when the incendiaries hit, why everything was destroyed except these safes that you'd still see and an occasional chimney.

But their job of rehabilitation, as a result, was a little bit easier. We didn't have to remove much in the way of debris before we could start some form of reconstruction. Whereas over in Europe-I was there in January '46, shortly after the war-you could see block after block where the structures were still there but everything inside had been destroyed, and in order to start rebuilding you had to go in and dismantle and remove them and take thousands, tens of thousands, of tons of debris out before you could even start to rebuild. So their problem, with heavy structures demolished by percussion and heavy explosives, was a much more difficult one than in Japan.

Q: Did you ever get to Germany while you were therein 1919, or did your tour specifically stay in France?

A: We did have a short visit to Koblenz, headquarters of the Army of Occupation.

Q: Now after your trip to France in 1919, you returned to Camp Humphreys and were there until early 1920. What were your duties while at Camp Humphreys?

A: As I said previously, that was when we went to school. They had the Engineer School going at that time, and that was where they were teaching electrical engineering, mechanical engineering, and whatnot. That school continued through June 1920. At the end of that course, the general who was the commanding general of Camp Humphreys at that time [Brigadier General C.A.F. Flagler] wanted me to be his aide. He had played football at West Point and always wore a little silver football dangling from his pocket. It should not be part of a uniform, but he was so proud of having played football, he always wore it.

Pierre Agnew (later Colonel Agnew), a classmate of mine, was then under orders to go to Europe. Agnew was very much in love with a gal in

Washington, and he just hated to think of leaving her and going to Europe. So he and I went up to the Chief's Office and we got our orders changed, so I didn't remain on as the general's aide but got orders to proceed to Europe in his place with the Army of Occupation in Koblenz.

Q: What were your duties at Koblenz?

A: They were having some difficulty with the commander of Company A of the 1st Engineers. He had married a German girl, and they thought there were some problems in the company, so in his place I was made commanding officer of Company A of the 1st Engineers.

I commanded the company for two years from then on. We carried on normal engineer training: building ponton bridges over the Moselle River, drill and rifle practice, and fortification exercises. I recall one occasion when we were ordered to prepare a defense position before General [Henry T.] Allen, commanding general of the US occupation forces [American Forces in Germany] and his staff. We were to set up different flags indicating where the defense positions would be, showing trench layout, machine gun locations, and whatnot. I can still remember to this day General Allen addressing the officers and saying that was the "finest defense position that I have seen in my service. " He extolled us quite a bit.

But our company was a very good one. We were number one in marksmanship, discipline, and I think in overall engineer troop training. We also had a football team, the 1st Engineers. We had only one battalion, Companies A, B, and D. We didn't have Company C. And we organized a football team of which I was captain and quarterback. Even though the 8th Infantry Regiment was much larger and the other combat units also were very large, our small football team tied with the 8th Infantry for the championship.

I might mention one little incident. We were teaching demolitions, fortifications, and so on. One day we prepared a so-called two-line crater charge. We also had prepared some fortifications and trenches around there where we had a number of filled sandbags. As the time for dismissal was getting late, when we were covering up the explosive charge, we took some of the filled sandbags and put those on the top in order to save time in covering it. When everything was ready and we released the charge, we got the two-line crater all right, but the sandbags went up intact in the air. The 8th Infantry had their barracks in the near vicinity and one or two of the sandbags came down and landed on the roof of their vegetable shed in the rear. It smashed through the roof and covered all the vegetables with dirt, whereupon the 8th Infantry called and said, "Please don't do that again."

Q: What was occupation duty like? Was it pretty routine?

A: Yes, very routine. We'd go out to the shooting range at Ransbach for target practice. Our company was billeted there. Late one night they had a large fire in the sawmill and lumber yard, so I organized our company and got them out and put out the fire. It was a big lumber mill that had caught on fire and it was quite extensive. We had our whole company go down, and we were the ones that extinguished it. We received the thanks of the *burgermeister* and his group for the wonderful work that we, enemy troops in occupation, had done to salvage and save his little community.

Q: What was Koblenz like?

A: Koblenz was a beautiful town. It had a very nice former German officers club that our officer personnel had access to. After World War I there was no war damage such as we had in World War II, so that Koblenz was relatively untouched, except for down at the comer of the confluence of the Moselle and Rhine rivers. There had been a statue of Kaiser Wilhelm there. When the forward units of the American forces came through initially, they decided that wasn't the place for it, so they just tore the statue down and destroyed it. There was the mount where the statue had been, but the statue had been removed and destroyed.

Living conditions there were very pleasant. General Allen was in command. Inflation had set in at the time we were there, with the mark about fifty to the dollar as compared to four to the dollar which it had been. As time went on the mark depreciated further, and in 1922, when we were leaving, the rate was about 300-320 marks to the dollar. That made it possible for the enlisted personnel to live high, even though the salary for a private then was about $21 a month or so plus 10 percent for foreign service. However, converted to marks it gave them salaries equivalent to some of the bank presidents. All the civic personnel in the town of Koblenz were getting less money than the ordinary private. As a result, the enlisted ranks were living high. In the mess halls they'd hire German girls and servants to do the cooking and other service work. So the GIs, as well as the officers and their wives, were living very comfortably due to the favorable exchange. This is just the reverse of the situation now where our troops in Germany are adversely affected by the high value of the mark and the depreciated value of the dollar.

Q: Who was your commander of the 1st Engineers?

A: Colonel [Bernard August] Miller, Bud Miller, then Lieutenant Colonel, was the engineer for the occupation, and as such acted as our commander, too.

Q: What other engineer officers, or non-engineers, did you get to know while at Koblenz?

A: Captain W. N. Thomas [William N. Thomas, Jr.], later a colonel, was initially an assistant in my company and then got to be a company commander.

Bud Iry, Captain [Clarence N.] Iry, commanded another company. General Dinty [Cecil R.] Moore, then a captain, was there at that time, but he was with the railway battalion in command of a company. He was not located in Koblenz, but in one of the outlying towns. We did get to see each other frequently. There was a Captain Pegram [Edward S. Pegram, Jr.]. I can't think of the names of some of the others.

Q: Did you get to see much of the rest of Germany outside the area of occupation while you were there?

A: I took occasion to go down on leave to Oberammergau to see the Passion Play. We also used to make fairly frequent trips out of Koblenz down to Wiesbaden and generally in that surrounding area.

Q: Were you fluent in German at that time?

A: Moderately so. I'd had three years of German in high school, and in the occupation you had the opportunity to increase your knowledge or further utilize your conversation with German servants and other civilians.

Q: Did you have any contacts with the German engineering profession while assigned to the Army of Occupation?

A: Virtually none; certainly little as compared later in the Philippines, where we had great contact with the engineer fraternity of the Philippines. But we had no real contact or association with the German engineering group at that time. Of course, in my later service as a Freeman fellow in Berlin in 1933-35, I had a great deal of contact with the German engineering profession.

Q: Did you happen to meet or talk to any former German Army engineers?

A: No, not at all.

Q: Do you remember anything about the politics of Germany at this time?

A: Well, at that time we saw a Germany that was down and out. The people had formerly been one of the leading powers of the world, and here it was crushed and its economy in ruin. The German people were fighting hard for an existence with shortages of many things, including fuel. Germany, with imports cut off during the war, had had to resort to synthetic fuel for their war machines. They provided synthetic materials for man y other things that were needed because their sources of supply had been cut off by the Allies.

Morale among the people was low, as I said. I had the opportunity to serve in Germany later in '33-' 35, and then I saw an entirely different picture. Then we saw a Germany on the rise. Hitler had just come into power, and everything was being done to build up morale and the military. But at the time we were in Koblenz, we saw a Germany that was defeated and down with a relatively hopeless outlook, particularly considering the harsh terms of the Treaty of Versailles, which incidentally were almost impossible to maintain.

The Allies had told Germany that they had to get along with an army of less than 100,000. They could have no major battleships, nothing over 10,000 tons. They could never have an air force. These conditions were not for two years or five years or ten years, but supposedly from then on out Germany was prohibited from anything in the form of any defense force or military force of any size or means.

As I say, you could sense that in the feeling of the people, as compared to what you saw later right after Hitler's succession to power, when we saw the German military and the people rise as against a Germany that had suffered defeat in 1918.

Q: Do you recall anything about the French policies in the occupied areas?

A: We had different zones. The Americans had our zone in Koblenz, the French had theirs in Wiesbaden, and the British had theirs in the Cologne area. We did sense that the attitude of the French was much more harsh and severe than that of the British and the Americans. You could still sense a sort of intense feeling of hostility and hatred between the two countries. Each one had been subject to war and invasion by the other, and it was more natural that there would be a greater enmity develop between those two powers as compared to the attitude between Great Britain and the United States versus Germany.

Q: Did you get to travel much outside Germany while you were there?

A: Not at that time as compared to later. In 1922 I was married in Koblenz to Dorothy Miller, the daughter of Colonel R. B. Miller, the chief surgeon of the American forces there. On our honeymoon we made a trip down to south Germany, Austria, and Switzerland. It might be interesting to know that we were on a ten-day honeymoon, and I told Dorothy that this was going to be an all-out operation, with no limit on expense. So we traveled first class, and after ten days, with a wonderful coverage of the best hotels, wines, and whatnot, I think I had a few pennies left of a $50 bill that the whole trip had cost. That is indicative of the terrific inflation that they had in Germany and Austria at that time.

Q: How did you meet your wife?

A: She was one of the four or five, you might say, eligible girls there. So there was quite a bit of competition with the large number of bachelor officers that we had. We would meet at the officers club, at horse shows, sports events, and similar activities. I was the successful one of several suitors and won my bride, the prize of the lot.

Incidentally, Joe Collins [J. Lawton Collins] was also married over there. He was married to the daughter of the chaplain of the American forces, Colonel Easterbrook. The weddings were something quite splendid. Both Joe in his marriage and we in our marriage were married in the kaiser's palace chapel. The kaiser had a palace and beautiful grounds there. So we were married in the kaiser's palace chapel, and after that had a beautiful reception on the grounds surrounding the palace.

University of Kansas and the Engineer Rifle Team

Q: You returned from Germany in May 1922 and were assigned to the ROTC unit at the University of Kansas. Was that mandatory assignment or did you request that?

A: I did not request it, but Colonel Perley F. Walker, who was the dean of the Engineering School at Kansas University, specifically requested my assignment because he was not satisfied with the officer who had been in charge of the engineer ROTC unit there. I had served under him in the 219th Engineers, so that was how he knew me and probably the reason he had specifically requested my services. It is not the type of, at least at that time, it was not the type of detail that I would have particularly requested or liked.

Q: Do you think it may have harmed your career at all at that time?

A: No. I think that probably using those four years in certain other activities might have been better insofar as I individually was concerned, in connection with professional advancement. But it was an interesting assignment and we enjoyed it. Lawrence, Kansas, was a delightful little town, and it was near Fort Leavenworth. Later Colonel Miller, Dorothy's father, was assigned to Fort Leavenworth as the surgeon. So it made it very nice for us on weekends to travel up to Fort Leavenworth and spend weekends with her parents.

We organized an ROTC rifle team there at the University of Kansas. I had been a very good shot over in Germany and elsewhere, and we turned out a rifle team that did extremely well in ROTC competition. Somehow the Chief's Office knew of my being a fair rifle shot, so I was ordered to join the engineer rifle squad, and during the summers of 1924 and 1925 and two succeeding years I was ordered to Fort Mott for competition and practice. There we had practice for six or seven weeks and then proceeded to Camp Perry [Ohio] for the National Rifle and Pistol Matches. Prior to '24, the engineer rifle team had joined with the cavalry as a joint team because our branches were small compared to the infantry or the marines, who had dominated the shooting prior to that time.

Well, in 1924, my first year, I joined up with Major Sturdevant [later Major General Clarence L. Sturdevant], the team captain, who chose me as his shooting partner. The ten-man team had to consist of not over five men who had fired in previous competition with the other five made up of novices or those who had not previously fired in a national match.

So he and I were shooting partners on this first all-engineer team. To the surprise of everybody, we won the National Rifle Match. He and I led off as the first pair on our team on the initial ranges and then at the final 1,000-yard range he and I were the last pair up. I remember I fired the last shot. Major Sturdevant's last shot had just given us the match by one point. So the observing crowd behind us shouted, "Shoot it in the lake, Casey, " but I paid no attention to it and got another bull's eye, beating the marines by six points to the surprise of everybody and the great jubilation of the engineers.

Oh, I might add one thing in connection with the national matches. They did have the so-called Infantry Match, with the competitive squad teams lined up in adjacent positions about 500 or 600 yards from the targets. At a signal your team would advance, say, 25 yards, lie down, take shooting position, and fire. You couldn't see the targets, which were screened, but you were firing at imaginary targets representing the enemy sited just above the butt level, the barrier that protected the target operating personnel. You were supposed to advance, fire, and then when you were sure you had sufficient hits on the targets, under supposed fire superiority, advance and then fire again. The unseen targets were changed each minute and a red flag displayed stopping further advance unless a stated number of hits were made on each target. Points were given on the time of the overall advance and on minimum ammunition expended. Of course, the infantry team prided itself as normally winning each year.

Well, to show how the engineers thought it out, we decided that what we would do would be to fire and then advance in successive steps without firing over almost two-minute intervals. I was team captain, so before firing again to get the required number of hits, I, with my wristwatch, watched the timing. About one minute and 45 seconds after each firing, I would order the firing of three or four shots to cover that advance, and then wait a few seconds after the second minute, and fire another three or four shots, knowing that our shots were so successful that they would have covered the targets adequately for almost the next two-minute period.

So instead of advancing and then firing every 25 yards as the others did, we'd advance that yardage, hit the ground but not fire, advance again, hit the ground again and so on. By watching the timing very closely, as it came toward the end of two minutes we'd give a burst of fire and then we knew that they'd be pulling the targets down, and after the two minutes give another burst of fire. Then we knew that we had almost two more minutes to advance by steps to the next place before we'd have to stop to maintain adequate fire coverage.

In doing that, we got so far ahead of the adjacent teams that our umpire, an infantry major, was afraid we were going to be hit by the adjacent bullets and he almost frantically ordered us, oh, several times, to stop before I finally did. However, it just showed how the engineers, by a little forethought, worked out a plan that succeeded in beating the infantry in their prized competition. We protested his ordering us to stop and virtually disqualifying us, so they authorized a rerun and another opportunity to do it, and of course we just came through winning hands down.

Q: Did you continue to work on engineering courses while you were at the University of Kansas?

A: None other than what I was getting in teaching the engineer ROTC students. I did not take any courses or undertake any specialized research at KU. However, I did organize the courses that we were giving to the students.

Ours was a little more difficult situation because the ROTC there was voluntary and not compulsory. In the land grant schools, all of the students had to take basic ROTC for the first two years. I had to do a selling job in trying to get the students to come in and enroll, and by reason of that we had relatively small units. That in turn made it difficult to get our courses to fit into the curriculum without conflicting with the other required engineer courses that these students had to take. As a result, I had to have two or three sessions in the same course because we had civil engineers, electrical engineers, mechanical engineers, and you couldn't get them all to get a common free time for the ROTC courses which they were taking. So I did have, even though it was a small unit, a greater number of courses that had to be given. I was the sole engineer officer on duty there at the time.

[Note: Casey wrote "Muscle Shoals" for the *Kansas Engineer* at this time, see Appendix B.]

Q: Did any of the students stay on in the Army?

A: Yes, several of them did. One in particular, I'm trying to think of his name. He was a cadet captain, and he was commissioned in the infantry later and served over in the Pacific. I ran across him there, and he was doing very well. He was with Sixth Army. I can't recall his name right now—oh yes, later a Colonel [August E.] Schanze. We had several others that went into the engineers.

Company Officers Course, the Engineer School

Q: In 1926 you returned to Camp Humphreys to take another course at the Engineer School. I think we discussed that somewhat already. This was your first real introduction to the civil works function of the Corps of Engineers. Was it already a foregone conclusion that you were going to receive a civil works assignment after graduation?

A: Not necessarily. People were normally assigned initially to military duty but the personnel office, I think, did try to conform to a general schedule whereby an officer would have certain graduate schooling, so much ROTC or organized reserve duty, so much military, and so much civil works service. I had not had any of the civil works duties as of then. I imagine that was one of the factors that they had in this assignment.

I think the other one was that from there I was sent up to Pittsburgh to take charge of the flood control survey in the Pittsburgh District. John Paul Dean, my classmate, had been in charge of that. He was ordered to the Chief's Office, and they needed to fill that slot, and I think John Paul probably recommended that I be assigned to it. That may have been one factor connected to my being assigned to Pittsburgh on civil works duty.

Q: Did any of your classmates or instructors at the Engineer School have particularly outstanding careers subsequently?

A: Instructors, we had Bill Hoge, and we talked about him. I had Bill Heavey, and we talked about him. Of the students, Em Itschner, later Chief of Engineers, was a classmate of mine, but he was one of the junior ones; and [Emerson L.] Cummings, who was later Chief of Ordnance, both with subsequent distinguished careers, but at that time didn't demonstrate anything particular. They were just second lieutenants and fellow classmates, and they didn't end up at the top of the class or at the bottom. They just went through with the run of the mill. I don't remember anybody special outside of Ed Leavey. He was very competitive and was fighting intensely with me to be number one.

Pittsburgh District

Q: Your first civil works duty was as assistant district engineer at Pittsburgh under Jarvis Bain. What were your primary duties in Pittsburgh?

A: The main purpose of my being sent up there was to take over from John Paul Dean the Pittsburgh flood control studies. Pittsburgh had sustained serious damage in 1907 from the " flood of all floods, " as they termed it, and John Paul had initiated these studies proposing a series of reservoirs on the various tributaries.

I was surprised to see that the program had not advanced further than it had. Much of the allotted appropriation had been spent, and there wasn't anything prepared on the report-it had all been field work investigation. So I was very busy in connection with preparing the report on that and finishing up the plans and estimates of the various flood control reservoirs. We had a number of reservoirs on the upper Allegheny River such as Red Bank, Crooked Creek, Kiskeminitas, and others; and on the Monongahela River, the Tionesta, Tygart, and others. We were primarily concerned with the protection of Pittsburgh and the lower reaches of the Allegheny, the Monongahela, and the upper reaches of the Ohio River.

I prepared this rather voluminous report. I might add that in doing this I had made a rather extensive hydrographic study. We studied potential rainfalls; we made up rainfall and runoff graphs of the different tributary basins; we worked out the relationship between rainfall and runoff and based on that we made plans for four different types of floods that could occur in the Pittsburgh area. We had plans A, B, C, and D, depending on—for instance, in one case where you'd have a flood on the Allegheny and then something would happen on the Monongahela, or vice versa; or another case where you'd have snow over the basin accompanied by rain, and so on.

We had these four potential situations, any one of which could have created a big flood at Pittsburgh, up to 45 feet on the gauge as compared to the previous flood of 35% feet on the gauge in 1907. When we submitted the report indicating a cost of nearly $100 million on these reservoirs and various works, a very large sum at that time, the Pittsburgh Flood Control Commission, a civilian group in Pittsburgh, retained a Professor Thomas, who was the dean of hydraulics at Carnegie Tech, to review our report.

One of the things that they pooh-poohed was our over-planning for a "flood that had never happened and never would happen. " But I felt that you should not put in a flood control plan, let's say with river walls for floods up to a certain elevation wherein everybody felt secure, when after that a flood in excess of that could happen. In such cases it would do more damage than if you had not had the flood control plan at all.

In any case, they had hearings in Congress on our report and neither approved nor disapproved the project but just filed it without action. It was interesting that in 1936, some eight years later, my Plan B flood came down right on the button and the flood came within 9 inches—below, not above—what our plans had showed. So within a matter of weeks they pulled out the report and Congress adopted the project for the flood control of the Allegheny and the Monongahela rivers and the upper Ohio, basically in accord with the reservoir studies and so on which we had prepared in our report in 1927-28.

Q: Flood control was a relatively new area for the engineers. I would assume that your work in Pittsburgh was relatively rare in the Corps of Engineers at that time?

A: It was. Prior to that time the only authorized projects for flood control were for the Mississippi River and tributaries. We had the Mississippi River flood control plan, and then we had some authorization, I think, on the Sacramento River. But the government had not yet adopted a policy of providing flood control on the many other rivers and streams spread throughout the country. It wasn't until later, you might say during the period when we were having the House Document 308 surveys, where we made studies of all important river basins in connection with their improvement for navigation, flood control, power development, and irrigation, that the federal government adopted a policy of providing flood control on minor streams and other streams such as the Allegheny and the Monongahela.

Q: Did you find any opposition among older engineers to Corps involvement in flood control surveys or work?

A: Well, I don't think any more than what prevailed generally. I mean, there was always the attitude on the part of some that the civil works type of engineering should be done by other civilian agencies and not by, let's say, a War Department agency such as the Corps of Engineers. There was jealousy between the Interior Department, because they were always working to get more projects for their personnel. There was a bit of jealousy and repercussion that way. But by and large, those were separate instances. For example, I was asked to give lectures and explanations of our projects to groups of engineers, and they all seemed very favorable to the work we were doing and what we contemplated doing.

Rivers and Harbors Section, Office of the Chief of Engineers

Q: Did you find my problem within the Corps to this kind of work?

A: I don't think so. I guess that in the Corps of Engineers there were some minority few who were involved in just the military phase and didn't think too much of the civil works activity of the Corps. But conversely, I sensed that those of us who were involved in civil works, such as flood control and later on lock and dam construction, and subsequently in the Chief's Office in the Rivers and Harbors Section, I sort of sensed that those of us who were in civil works felt sort of a little superiority over those who were just involved in the Military Division.

I think that attitude grew within you because you saw that you were doing work of major responsibility and major expense and importance, as compared to what the engineers or other personnel in the military services were doing in peacetime on their military function. There they were limited in funds for their activities, and it seemed comparatively as just a sort of routine function in being with troops. So if anything, you seemed to sense that those who were involved in the civil works program might have looked down on the ones in the military as sort of a secondary group of personnel.

Q: Did flood control appear then to be as potentially significant for the Corps as it became after the Flood Control Act of 1936?

A: I don't think at that time the country was ripe for it. Only those of us who were involved in it—and there were very few at that time [who] really thought so—I think the Pittsburgh flood control survey was the only one that I know of as of that time. But being involved in it, I, and those in the review later, felt strongly that there was a field for the Corps of Engineers.

I think the way the Corps of Engineers is set up with districts, its divisions, its coverage of the country, its readiness to move trained and experienced personnel from one district to another as the need for specialized engineering or development occurs and its varied engineer experience, are all material factors in preparing the Corps of Engineers for such a function, as compared to establishing a brand new agency nationally or in any particular area.

Q: What was Jarvis Bain like?

A: He was a stubborn type commander. He did not seem to have a particularly likable personality. We sort of sensed that in some ways he was Scotch in nature. For example, we had limited funds, limited material, for our flood control survey. We had one small car that was used in connection with our field survey work. The tires on the car were shot. We put in a requisition to get four new tires. He turned it down and said that we should turn them in and get four used tires.

Here was an example of penny penury and pound foolish, because if you had that survey party out and with those used tires something conked out, you lost a half day or more of valuable time of the crew, and you had their expenses and so on, as compared to the savings of pennies in getting a used tire rather than a good new tire.

But at the same time, even though he was saving pennies, there he would sometimes take his car and a party, go up to the head of the Monongahela River, get on his inspection boat, and then come down the river on the inspection boat and the car would have to return to the district office empty. I mention that only as indicative of how he was sort of telling us to cut down and hold down here and there, and yet by his example he was doing something otherwise on his own. I didn't think that Jarvis Bain was one of the engineer officers under whom I served who would ultimately be Chief of Engineers or attain any major position in the Corps.

Q: How about Colonel C. W. Kutz, who was the division engineer?

A: Kutz. Colonel Kutz was a very able and respected officer. As division engineer, I had very little to do with him because at that time the district engineers were functioning rather independently. I think it was later on in General Brown's [Major General Lytle Brown] term as Chief that they adopted a new policy in the Chief's Office of building up the division offices and delegating a greater amount of control to them. In later years I sensed the division engineers were more active in control of their divisions than they were at that time where division engineers seemed to be more an office through which administrative papers and so on would be processed between the Chief's Office and the districts. I did not sense that the division engineer exercised any major direction or supervision of the activities that were going on in the districts. So I had little to do with Colonel, later General, Kutz. Incidentally, he was father of the charming girl whom Tenney Ross, a classmate of ours, married. She's a wonderful person.

Q: While at Pittsburgh, were you engaged in any of the preliminary work for the comprehensive river basin surveys mandated by House Document 308?

A: Not at that time, but I was subsequently, in the Chief of Engineers' Office, very much involved. Because in the Rivers and Harbors Section we were in touch with all the divisions, all the districts, all the civil works activities of the Corps throughout the country; both on flood control and current developments, as well as on these continuing House Document 308 surveys.

I might add though, in connection with Pittsburgh, in case you're leaving that, that the second year after I had finished my flood control survey and submitted the report, I was engaged in supervision of construction. We were building a second lock on Lock 4 on the Monongahela; we were building a new lock and dam at Dams 6 and 7 or 7 and 8 on the Allegheny; and we were building the uppermost dam on the Ohio River. It was then called Deadman Island's Dam but later had its name changed to Dashields Dam. It was a very interesting assignment because I was involved there in the actual construction of locks and dams and other major structures in that important area.

Few people realize that the little Monongahela River carried more traffic than the Panama Canal. It was very important, particularly to the steel industry, moving ore and steel and other bulk traffic through that relatively small stream.

Incidentally, when our flood control reservoirs were finally built later, we also had provided for joint use for some of the reservoirs so that they could store part of the flood waters and during the low-water season could release them to improve low-water flow. That was very important, particularly on the Monongahela River, because it had very heavy traffic but limited low-water flow, so that during periods of low-water, the shortage of water needed for the frequent lockages became critical. For instance, the Tygart River reservoir and the other reservoirs at the heads of the basin helped materially in providing an increase in the low-water flow during those critical low-water flow periods.

Q: How significant was the completion of the 9-foot navigation channel on the Ohio?

A: I think it was very, very important-particularly now, for instance, when you read of the shortages of energy, the difficulties of truck transportation, and the problems that the railroads have.

When you think that water transportation is the cheapest form of transportation of mass commodities, the provision of an improved system of waterways has been a major contribution toward the development of the country as well as in the improvement of commerce and in the saving of energy as well.

I know that there was a lot of criticism of the Corps in the early days about its development of the Ohio River for channelization, even with the 6-foot project, let alone the 9-foot project. But all those criticisms can be washed out by merely analyzing just what the annual commerce is on the Ohio and its tributaries, and figuring out both the fuel and money savings that are attained as compared to rail or truck travel and also considering the potential that it gave for development of that whole area as an industrial and economic development region.

Q: In 1929 you wrote a detailed article in *The Military Engineer* on Deadman's Island Lock and Dam. (See Appendix C.) What prompted you to write that article?

A: One thing, *The Military Engineer* was paying $10 or $20 or something like that for an article. I know it was some insignificant little fee. But principally I felt that it was desirable to put into the literature an example of one, at that time, relatively important engineer project of the Corps of Engineers. So I just took time off and wrote it; I haven't seen it for years and I don' t even recall all that's in it. But I assembled all pertinent data in connection with its design and construction and prepared and wrote that article and submitted it, and they happened to publish it.

Q: Well, in your article you distinguish between movable and fixed dams. Could you explain the differences between the two?

A: Well, a fixed dam would be a concrete structure across a stream. It would have a spillway over it or through it depending on the height of the dam. A movable dam is one where you have some arrangement whereby if high water is approaching you can lower the structure or parts of the structure. For instance, if they have the movable bear-trap, they could open those during high flows; or if you had the wicket type of movable dams, you could lower the structures and the water then flowed through without obstruction and that would permit, for example, during high water, commerce to proceed across the lowered dam without having to go through the locks, eliminating the time-consuming period taken to go through a lock. They are feasible only where you are going to have long periods of navigable depth flow or sometimes where you might have so much high water that with the fixed dam, without an excessive amount of openings, you would be flooding the area upstream during flood flows.

At that time we had only the movable-type dams on the Ohio, basically the wicket and bear-trap type. Later on, when I went over to Germany, ‘ 33 to ’35 on my research work there, I did an extensive amount of traveling to inspect the various hydraulic laboratories in Europe. I also took occasion to inspect, with personnel from the German government waterway groups, the locks and dams and so on that they had. They had developed much bigger structures for movable dams. They had the roller-type dam; they had the *Drei Guert Schutze,* a triangular-type device. The movable parts would be 100 to 150 feet or more long. I assembled plans and data on these various structures and sent them back to the Chief of Engineers’ Office. Subsequently, and currently in the case of a movable-type navigation dam or for flow control through fixed dams, they’re virtually all made now with these long roller-type structures and similar structures such as they had developed in Europe rather than the wicket and bear-trap type.

Q: At Deadman’s Island, you noted the steel interlocking sheet pile caissons were used for the first time on the Ohio River. How significant was this use?

A: I hadn’t recalled now that that was the first time, although I guess it was. But the matter of cofferdams is a very important phase of dam construction. In order to provide space to build a lock you have to unwater the area to work on the foundation and the structure itself. That requires provision of a barrier enclosure, permitting pumping out the enclosed area and holding it dry during the construction phase. In building the cofferdam using interlocking sheet piling you could sink a series of adjacent sheet pile cylinders and interconnect them, filling them with excavated materials. That made an excellent type of cofferdam barrier to protect the working area inside. And after the structure was completed, you could retrieve the sheet piling for use again as a cofferdam on other structures.

Q: Pittsburgh was your first civil works assignment. How important do you think this experience was for you personally and professionally?

A: Most important. I thought it was a wonderful opportunity to get into the type of engineering particularly that the Corps of Engineers was involved in. I had the opportunity for hydraulic research and study on flood control. For instance, in the annexes or appendices in that study I showed how to figure out the effect of valley storage in computing the effectiveness of reservoirs. You can put a reservoir on a tributary and maybe you're going to reduce, let's say, 5,000 cubic feet per second from that tributary from its peak flood flows. That's what you reduce at the dam, but you can't claim that much reduction further downstream because if that flood had continued on through the tributary, much of it would have remained in storage in the river valley before it got up to flood height some distance below. So the effect of holding back, say, 5,000 cubic feet per second up here might be only 2,000 or 3,000 cubic feet per second at some point below because of the intervening valley storage effect that you would have had during the flood, as compared to not having it with the reduced flow from the dam.

People could go wrong, for instance, when they're analyzing a series of reservoirs and their effect on flood control if they just found out the hydrography of the flood flow entering the reservoir in each of those dams, adding them all up and saying that you took that much off the flood peaks below. You wouldn't because you have to compensate, in determining the reduction in the peak flood flows, for the effect of valley storage in the intervening reaches. In an annex in my report I indicated a method to determine that valley storage effect.

Q: Was your work at Pittsburgh what resulted in your assignment to the Chief's Office in 1929?

A: I believe so. As I said, I was there and John Paul Dean was then in the Chief's Office. He was working with the Board of Engineers for Rivers and Harbors and particularly with Colonel [Ernest] Graves on Mississippi River flood control. I think possibly the recommendation of John Paul Dean or the fact that I'd worked on both flood control and lock and dam construction may have been factors. The Chief knew about my work on the Pittsburgh flood control study because I'd taken the report down when it was completed and we had hearings before the Board for Rivers and Harbors and before the Chief, so they knew of that. In any case, I was ordered there.

Q: From your previous comments I gather that you think that your experience in the Rivers and Harbors Section, the Civil Works Division, was crucial?

A: Very. I think that probably as far as civil works are concerned, it was one of the most important assignments that I had in my career. I was a relatively junior officer, but by reason of the assignment I had, I was sort of at the central point where everything pertaining to civil works came.

All reports, such as survey reports and preliminary examination reports, came through there. We had to prepare reviews on them for the Chief's action; requests and numerous items of correspondence from congressmen and senators in connection with projects in which they were interested came in, and we had to formulate replies to those for the Chief of Engineers' signature. I had adopted one policy, and that is that when something was referred to us I wouldn't go up and ask General Brown or General Pillsbury or Colonel Kingman or Colonel Daley what should we do on this. But I would formulate a reply or an endorsement or whatever indicating what I felt should be done.

They could change it or approve it. Well, it was rarely that we had any material changed in the type of action that was prepared. So it was a wonderful opportunity to have a review of all of the varied functions of the Chief's activities, not only on rivers and harbors improvement and flood control but also hydroelectric power. The applications and plans of private utilities seeking permits from the Federal Power Commission to develop hydroelectric power on our various navigable streams were always referred to the Chief of Engineers. We'd have to make a review and recommendation on them as to the effect on navigation and as to any requirements that we might have to put in in connection with such development, insofar as navigation was concerned.

The district engineers often were coming in in connection with getting additional allotments for continuation of some of their studies and so on. For instance, I can recall General [Brehon B.] Somervell, who was then just a major, coming in to my office requesting increases in some funds that he required for his examinations and projects in the Washington District. He was district engineer in Washington at that time. Later on he was the supreme power on our 1941 construction program, and I was operating under his command.

Q: How much did you have to do with the Chief of Engineers at that time? Did you see the Chief of Engineers very much?

A: Not too frequently. I saw the Assistant Chief, General Pillsbury, much more because my office was right adjacent to his. I say "my" office; I mean the chief of the Rivers and Harbors Section, Colonel Daley, and later on Colonel Kingman. Our office was right adjacent to General Pillsbury, so we frequently stepped into his place or he stepped down to ours in connection with matters, and occasionally we would go in to see the Chief. Initially General Deakyne was the assistant chief, and then he was relieved by General Pillsbury. General Pillsbury was the assistant chief during most of my service there.

Q: What were your impressions of General Lytle Brown?

A: A very likable, very able, Chief. I don't think that Lytle Brown was the outstanding technical Chief, as compared to General Pillsbury. General Pillsbury, I think, knew more of the engineering problems and soon that the Corps had, and in particular the technical phases of river improvement, hydraulics, and so on. Whereas Lytle Brown was a wonderful personality with great ability to get along with congressmen or senators or groups coming in or in his contacts with people. And also he kept a very nice shop, you might say, of the personnel working under him. We were all a happy family and everybody respected and liked him.

Q: What was your impression of Colonel Daley?

A: Mick Daley was a most likable person. He was not one of the greater technicians of the Corps-he operated more in an administrative capacity. I doubt that he ever corrected anything that I had prepared for him, so he wasn't one who would adopt a different view on what we were preparing or proposing. It was too bad later, when he really had a great opportunity during the outbreak of World War II, when he was sent over to Europe-I don't know if he would have been a corps commander or such, but something happened and he was returned to the States. I think Colonel Daley was probably more suited for the military phase of operations, possibly, than the engineering or technical phase of the Corps of Engineers' work.

Q: How about Colonel John J. Kingman?

A: Colonel King man was a slower moving person. A very nice personality, very quiet. I think I told you the other day about the mooring bit? Did you want information on that, for example? At that time we were conducting the House Document 308 surveys and the plans and data were coming in on the Tennessee Valley development. That was going to involve a series of high dams, as compared to the lower dams that we had had on the Ohio and other streams. That was also going to be the case on the Columbia River, where we were going to have very high dams for joint hydroelectric power development and navigation.

They had had trouble shortly before that up on the St. Lawrence Waterway, where they also had high dams. They had trouble in transferring lines with the fixed mooring bits that they had on the inner walls of the locks; including drowning of personnel trapped in making such transfers. Any ship entering the lock chamber was subject to terrific surges during the filling or emptying process in the lock. It was therefore necessary to secure it to these fixed bits along the sides and then transfer the lines up or down as the vessel rose or was lowered during different stages of the lockage. Colonel Kingman said he was much concerned about that with our projected high dams. I thought there might be a solution to it, so I sat down and worked up some sketches and thought it over for a day or so, and then came up with the concept of a floating-type mooring bit. It would consist of a tank with rollers or wheels on both sides, operating on tracks in a recess in the lock wall, with the mooring bit attached to the top of this floating tank. In that way, as the water raised or lowered, why the tank would rise or sink, always keeping the same relative elevation above the water level, no matter whether it was rising or falling with the variation in water levels.

Kingman was quite impressed with it, so he had me make further detailed plans and write-up. At that time the Corps of Engineers was being sued by a former Engineer Department employee for royalties on a development he had made in connection with bank revetment. So Colonel Kingman said, " We've got to get out a patent on this to protect the government so we won't be subject to royalty patent claims. " So he said, "We'll get a patent. " This was just before I was due to leave for Germany. I had been awarded this Freeman Fellowship for Hydraulic Research, so I left. But about a month or so after I arrived in Europe, I got an application for a patent on this floating mooring bit for my signature and so on, which I signed. I noticed it was a patent in the name of John J. Kingman and Hugh J. Casey, in that order. But his contribution had been mainly in getting our legal group and our draftsman to effect the patent application on my original concept. I noticed that later on it was referred to as the "Kingman floating mooring bit, " but as I say, I happen to know just who it was that did develop it.

Q: Was Colonel Graves then the chief of the Civil Division?

A: No, he wasn't the chief of the Civil Division. He was a retired officer who had been called back to active duty and his function was being in charge of the Mississippi River Flood Control Section. That was his primary, principal job, so all matters pertaining to the Mississippi River flood control, and there were many, were handled through his office, with John Paul Dean as his assistant on most of the technical phases of any reviews and problems that they had.

Q: Who was the chief of the Civil Division at that time?

A: That's a fair question. I believe the Assistant Chief of Engineers (then Brigadier General George B. Pillsbury) sort of acted in that capacity. I don't have any recollection of anyone other than the chief of the Rivers and Harbors Section and the Assistant Chief of Engineers.

Q: OCE [Office of the Chief of Engineers] had a relatively small staff of engineer officers at that time. Who were some of the people there besides yourself?

A: Well, Dinty Moore was there. I think he was involved with legal matters in connection with accounting and legal reviews, particularly involving contracts. I think he was in the division that handled contracts. There was John Paul Dean, as I stated previously, and there was also A. B. Jones. He was with the Rivers and Harbors Board, and also a very able officer and a fine technical engineer. He was very active in the review of reports that came in from the divisions and districts prior to action by the Board of Engineers for Rivers and Harbors.

Q: What about John Bragdon?

A: Yes, Bragdon was there. I am trying to think of just what it was that he did. I don't know if he was in the contract section along with Dinty Moore, or—

Q: Apparently he was in the Finance Division.

A: Yes, I think he was in the Finance Division. 1 think he handled the finance end of it. I know that Dinty Moore would deal with him in connection with legal reviews of contract matters.

Q: Leslie Groves was in the Military Division?

A: Groves was in the Military Division. I don't think he was doing anything particularly outstanding that I can recall. At that time those of us in the Civil Works Division sort of—I wouldn't say looked down on those in the Military Division, but we felt that they weren't doing as important work as was being handled in the Civil Works Division. You must recall that this was in the period of '29 to '33 and the country had just gone through the crash of '29. The economy was down, and the administration decided that there was need for an accelerated and expanded public works program. So the Corps of Engineers was given much bigger appropriations than they had had in the past, with the view of spreading work around to the various communities throughout the country. As a result, the Civil Works Division was far more active during that period than they had been before. Congressmen and senators were continuously coming in, pressing for projects to be developed in their various areas. Our office was extremely busy reviewing reports, plans and specifications, and allotting funds.

At that time Patrick J. Hurley was Secretary of War and MacArthur was Chief of Staff. On some matters our correspondence had to go up to the Secretary of War's Office in connection with a number of the projects and, though I didn't have personal contact with the Secretary of War's Office, our Chief did. But by reason of the general economic depression that prevailed throughout the country, there was a very great acceleration of Engineer Department activity in rivers and harbors and flood control. We were getting increased funds and making increased allotments and pursuing a much more active construction program throughout the country. This was not the situation at that time in the Military Division where Groves served.

Q: Do you believe that such public works or civil works as then engaged in by the Corps of Engineers was the way to reduce the burden of the depression?

A: Well, it certainly helped. I don't think that the solution to pulling the country out of a depression is by a massive public works program, but I do feel that there should be a bit more balancing of it. For instance, if the economy is riding high and the government is getting large tax income, there is an inclination on the part of many agencies, including the Chief's Office as well as others, and pressure from various communities along the lines of, 'As long as we have the money, then let's get it now, " and "Let's build this or that. "

In doing so, we are competing with private enterprise at a time of high prices and therefore at high cost. But what we should do is to regulate it; not in detail, but generally. When you have a period of prosperity, it is not the time to be pushing a public works program, even though there is a tendency to do that because funds are available, and all the agencies are getting increased funds. And they go out and compete against each other as well as against the private sector and the prices go up and you get less per dollar expended. Now, if some of that is deferred to a period of depression, such as we are approaching now, why then is a time to take some of these projects and put them into the pot at that time, and that would tend to equalize it.

But I do not think that just because we are in a period of depression we should reach out and scoop up every potential project and then get all the funds possible and then pour it in as a solution to an economic depression. That applies not only to the Corps but also to the Interior Department, the Bureau of Reclamation, the Highway Department, and other public agencies. We should concentrate on studies and plans for needed development during periods of high economic activity so that such plans would be ready for execution during periods of recession.

Q: How much change was there in the Rivers and Harbors Section from the administration of Herbert C. Hoover to that of FDR?

A: Not any material ones. It just meant that, I think, those of us who were there worked harder. For instance, we'd be working into the night in the Civil Works Division. Of course, the Military Division, they were leaving promptly at 4 o'clock, or whatever time they terminated. We also frequently worked on weekends. It was a case of personnel working a bit more rather than by expansion of personnel.

Q: When Roosevelt launched his large public works program, how important was it that you had available some of the early 308 reports to allow you to begin to plot out a project?

A: The whole program of House Document 308 reports was excellent. Here you prepared the groundwork, doing the basic engineering in advance in a calm, relatively calm, period, not under great pressure. Later on there was great pressure to complete them, but the whole basic program of preparing in a timely fashion potentials for development of the various river basins was a wonderful concept. Later on the availability of these reports made it possible for the Congress and the Senate and soon to reach in and pick their favorite projects and get authorization and funding for them, and to permit their execution promptly rather than getting the funding and then maybe waiting a year or more in engineering investigation and planning before you are able to do the work for which the money is provided.

Q: In the 308 reports, did you find generally that the Corps officers involved in preparing them were thinking of civil works in a much wider framework than they had in the past?

A: Oh, definitely, because prior to the 308 reports, why, the whole concept—as I sensed it—of the Chief [of] Engineers' Office was for navigation improvement and Mississippi River flood control and the Sacramento River flood control, such as it was. The whole concept had been basically one of improvement for navigation or reviewing projects of the Federal Power Commission affecting navigation. If they were getting ready to grant a permit for hydroelectric power development to some private utility, the proposed project was referred to the Chief's Office and we reviewed them mainly from its impact on navigation as to what requirements should be met. But with the 308 document the districts were required to analyze the potential development of a whole river basin, not just the navigation phase but what were the possibilities for hydroelectric power development or for irrigation-even though that was primarily the field of the Bureau of Reclamation of the Interior Department, but it was still a function that we reviewed. We had to consider power development, irrigation, flood control, and navigation.

Q: Do you think that the Corps may have lost some major projects, like Grand Coulee, because of the reluctance of some of the leadership to forge ahead with new areas of water resource work?

A: Well, I don't know; it's hard to say whether it's that or to what extent it's the pressure of some local interest groups. Of course, as to Grand Coulee, I think we had started its concept in a 308 survey. We took a big step forward as compared to the Interior Department and their Bureau of Reclamation. They were concerned primarily with irrigation-they sort of were stuck with that. When they saw the Corps of Engineers get in and start our 308 surveys, there was an intense spirit of concern and competition engendered by that, and I think they went out and tried to grab as much of it as they could. I think that was one factor that probably influenced the Grand Coulee.

As far as the Tennessee Valley development was concerned, I think you had a group of outsiders who figured they wanted to get in on the kill, and through local organization and political support they set up the Tennessee

Valley Authority, which took the development away from the Corps right in the middle. Here we had developed the plans and the whole concept, and part of the structures initiated-and then they setup this independent agency. Of course, the TVA then got great acclaim for what they had done in transforming the Tennessee River basin, yet basically it had been initiated by the Corps of Engineers.

Q: Basically, then, TVA was the 308 report for the Tennessee Valley?

A: Yes. I mean, they sort of took it over with a separate agency doing the development.

Q: In reviewing the 308 reports, were you particularly impressed by any of the personnel who prepared these in various districts and who went on to have subsequent important careers in the Corps?

A: Yes. Who was it on the Tennessee report? I was impressed with him and the reports they were making. I was impressed, too, with A. B. Jones in connection with his review of these reports for the Rivers and Harbors Board. But I don't recall anybody in particular as of that time who contributed something special or outstanding. I thought that the 308 surveys that came in from the Tennessee Valley were among the best. I am trying to think who the district engineer was, and who some of the civilians were who were working on that. I thought they were generally among the best.

Q: What was your opinion of Harold L. Ickes, Secretary of the Interior?

A: Well, I didn't have too much of an opinion. I didn't admire or think too much of him. I know that Ickes was thinking of Ickes continually on the various activities in which he was engaged. He was a power seeker and was quite active in advancing every cause or movement in which he was interested. I didn't think he had any particularly outstanding technical ability that contributed to any of the developments in which he was interested or pushing.

Q: What important civilians in the Chief's Office did you get to know while you were there?

A: Well, old Mr. Gerig, who had been there for years and years. He had been the recognized expert in the dredging field. Mr. Giroux was the efficient head of the Marine Design Division in the Chief's Office. We were preparing plans for different types of dredges, such as pipeline and sea-going hopper dredges, and other critical floating plants.

Q: What about Judge Koonce?

A: Judge Koonce was outstanding. He was in charge of our Legal Division, and I think he was the outstanding authority in America at that time in the field of law as it affected navigation and navigation improvement. There were man y problems that would come up, particularly on permits for structures affecting navigation—for instance, when people had to build a highway or railway bridge or they were going to build a hydroelectric power project. Questions would come up as to whether or not it was necessary for a power project to go through the Federal Power Commission to get its permit, and the only basis we had was whether or not it affected navigation and to what extent. There were questions of fact and law in the resolution of these problems. But in connection with any legal problem that came up with contracts or permits or authorizations for projects, why Judge Koonce was the final authority as far as we were concerned.

Q: Did you have any work at all at that time in the area of pollution control?

A: Not particularly. Certainly nothing like what it is now. For instance, it was considered perfectly proper for us in hopper dredging to scoop up material from the channel bottom, take it out to sea, and dump it, but not necessarily taking it out a hundred miles or so, but just dumping it when you got it out of the way. We did not then have any project for soil conservation, you know, including beach protection and erosion.

If, for example, we were going to build a large dam and reservoir, possibly involving flooding of private lands, relocation of roads or railroads, we would always arrange a public hearing and proponents and those who opposed any such developments had an opportunist y to be heard, and their views were considered in connection with the action that was to be taken. But insofar as considering pollution, or correcting pollution, it was not a determining factor. We did, however, consider it in connection with the Monongahela River improvement. There was a lot of pollution in that stream, because the various steel industries were pouring out waste into the waters, and the Monongahela River was really a mess, and our proposed flood control reservoirs were planned to effect some improvement in control of pollution as well.

We had no authority then to take any action to correct the outpouring of any such materials, but we did take into consideration the fact that reservoirs on that waterway would, by providing increased flow during low water periods, assist to a degree in reducing the pollution problem. But insofar as projects for correction of pollution per se were concerned, it was not a factor nor a responsibility nor an authority that the Corps had.

Q: How did the River and Harbors Section function with the Mississippi River Commission?

A: The Mississippi River Commission was under the Chief of Engineers. Matters pertaining to Mississippi flood control in connection with the authorizations and so on would have to come from the Mississippi River Commission to the Chief of Engineers' Office. Principally they would be referred to Colonel Ernest "Pot" Graves and his section, and then to our section, too, for action by the Chief. But the Mississippi River Commission, although it was largely independent in many phases of details, was still under the authority, direction, and supervision of the Chief's Office.

Q: Did you have any direct connection with the congressional committees that handled public works?

A: Usually in the hearings before the congressional committees either the Chief of Engineers and sometimes the Assistant Chief of Engineers, but mainly the Chief of Engineers would appear. Sometimes he would take assistants with him, usually taking the chief of the Rivers and Harbors Section, let's say, Colonel Daley or Colonel Kingman, and occasionally I was taken up on some matter of special concern. Colonel Graves would be pulled up if it were a matter affecting flood control. Colonel Graves had one special qualification that gave him an advantage in some of the hearings. Colonel Graves was hard of hearing. In fact, he had been retired for a hearing disability. But if there was a hearing in front of a committee, and some question came up which was maybe a little embarrassing or something that he didn't particularly like, Colonel Graves would raise his hand to his ear and have the man repeat it maybe once or twice, which helped to disarm that particular person in connection with his query. But, he would also be sitting there, and up at the far end of the table some senator or congressman would say something maybe a little adverse about something and Colonel Graves, down at the far end of the table and deaf as he was, could immediately rise and give a response to it. That possibly disarmed him in the eyes of some people as to the extent of hearing disability that he had. He was a grand old guy.

Q: Can you tell me a little about Colonel Graves?

A: Well, he was big and husky. He had been an outstanding lineman and later the line coach up at West Point on the football squad. As I said, he had been retired for physical disability and had been called to active duty and assigned to head up the Flood Control Section in the Chief's Office. I don't know what particular experience he had had prior to that that gave him that qualification. I think he had served on the Mississippi River Commission before that. He was not a master of the King's English. For instance, if something came in and he prepared an endorsement on it, it would be terse, blunt, and brisk. On occasion I would take it back to him and would suggest some different wording to tone it down. He would say, "No, but leave it as it is."

Well, sometimes we would leave it as it was, send it up to General Pillsbury, and Pillsbury would cross the thing out and then we would have to reword it in a little more tempered tone, maybe giving the same ultimate answer, but not as abruptly and directly as old 'Pot" Graves would give. He was one who came out with a direct answer, a blunt answer, and you might say that his action and correspondence typified what his actions would be as a line football coach on the football team.

Q: Apparently he was quite involved in things like *The Military Engineer* and the Society of American Military Engineers (SAME). He was one of the founding members of the society.

A: Yes, but I don't know that he took any special activity on that. I know that he did make a very good homemade wine. It was during Prohibition. Occasionally he would invite you down to his place for some of his wine, and it was potent, though not a vintage variety.

Q: What other Army officers did you meet or become friendly with during your time in Washington?

A: Well, we met officers of other branches. I don't recall anybody who later developed into any outstanding role in one of the other branches. General MacArthur was Chief of Staff, and I know one time I was assigned to a military board where we were to review the rifle and ammunition that the Army was using, and we came up with the recommendation that we adopt a smaller-type cartridge and a lighter-type weapon, figuring that it would be lighter to carry in combat and so on, and the ammunition would be easier to procure and develop in quantity and whatnot. Actually, later on during World War II we did develop such a weapon. But when we sent our report in, even though the board unanimously agreed on it, it went up to General MacArthur and he disapproved it completely. He wanted us to continue with the Springfield rifle and the .30 caliber ammunition that we were using at that time.

Q: General Leslie Groves wrote some comments shortly before his death dealing with a number of different subjects. One of his comments concerned you, Lucius Clay, and himself. He said that when the three of you were serving in the Chief's Office in the early 1930s, you three decided that if things didn't go terribly wrong for any of you that you would be on top in the Corps of Engineers before the end of your careers. Is this so?

A: Certainly as far as that time was concerned, I did not consider that Lucius Clay was going to be on the top because up to then he had just been in military duties. Subsequently he succeeded me up in the Pittsburgh District as assistant to the district engineer up there, and at that time doing routine work, including continuation of the lock and dam construction program. There was no flood control activity thereat the time.

Later on, I think, after Lucius had served in the Chief's Office and also had been out with me in the Pacific, I felt that Lucius was headed toward the top. I did not think that I was qualified or had the potential, certainly at that time to which Groves refers, to attain the top, and I definitely did not think that "Goo-goon Groves was going to be one of those three. I think that later on, as he got in with Somervell on construction and then particularly later in the Manhattan Project, I would have such views as to him, but prior to that I did not. I think I should have thought more of Groves' potential as of that time if that is what he thought of us. I can conceive of his making these comments later, by reason of our later activities, but certainly, in my views, not as of that time.

Q: So then it's a case of Groves making a slight exaggeration?

A: Well, as I said, these comments that he made probably were post, after the fact. He certainly never made such comments to me around that time that he thought that we three were probably the ones that were going to get to the top, because I don't think he thought so then, and I certainly didn't think so then.

Q: But you sort of still knew each other by your nicknames?

A: Yes. I mean, I was a "Pat" when I went up to West Point. I was not a "Pat" before then, but "Pat" seemed to be an appropriate name to go with Casey. Then my brother, when he went up to West Point, he was Martin Charles Casey, but "Pat" seemed to be an appropriate name for him, so they called him "Pat" Casey, so there were two "Pat" Caseys in the Army, both brothers, and it was pretty hard to tell which was which. Lucius didn't pick up any particular nickname, but a lot of others did. Pat Tansey was a "Pat," Pat Timothy was a "Pat." Cecil Moore was a "Dinty''-some of these nicknames are given to people and then stick with them.

Q: In 1933 you wrote an article–again, for *The Military Engineer–on* waterways and flood control that outlined what we talked about, your concept of how to remove the ills of depression by public works. (See Appendix D.) Do you remember what prompted that article?

A: Well, I think it was based on my experience there in the Chief's Office. Here we were on a vastly expanded public works program, and we saw how helpful its impact was. Now, I don't remember what my final conclusion was; I haven' t seen that article for years. But generally I believe it said that major projects should be kept in cold storage during peak economic periods so that you could pull them out and do them during periods of depression. With that, I think, I would still agree. But if I was saying that every time you had a depression you reached in and you did all the public works you possibly could do as a corrective factor, why, I don't think that that is the basic thought that I would try to get across.

Scholarship and Advanced Engineering Studies in Germany

Q: How did you get the John R. Freeman scholarship, and what exactly was it?

A: Well, [Herbert D.] Vogel was over in Europe at the time on hydraulic laboratory research. Having been four years in the Chief's Office and also knowing about the hydraulic laboratory that we had down on the Mississippi River and sensing its importance, I thought it would be desirable to find out further and to do graduate work in that field and see what we could do in the hydraulic laboratory at Vicksburg in connection with solving many of our problems in river control. Such problems might embrace river regulation, control of excessive silting, and spillway control structures.

Europe had a number of hydraulic laboratories. I still have a large book by Dr. Freeman on hydraulic laboratory practice in Europe which covered a number of the laboratories there and the work they were doing. So I thought it would be desirable if I could research that field. So I applied for a Freeman fellowship. Three engineer societies were awarding them: the Boston Society of Civil Engineers, the American Society of Civil Engineers, and the American Society of Mechanical Engineers.

So I applied to all three. Two weren't giving them that year, but I was selected to receive the Mechanical Engineers' Society award. It was to be for only one year. Unlike others, I had been sending monthly reports of my activities to both the ASME and the Chief of Engineers. In order to continue my research project, I requested an extension for a second year, which they granted. So I was over there for two years.

At that time, as far as the Chief's Office was concerned, it was contemplated that I was going to head up the hydraulic lab in Vicksburg. During that period I traveled all over Europe, visited all the principal hydraulic laboratories as well as the principal navigation works. In many of the areas I inspected their locks and dams. I also contacted the manufacturers of some of their very large roller-type movable dam equipment, their *Drei Guert Schutze* and others–MAN *[Maschinenfabrik Augsburg-Nurnburg]* and *Vereinigte Stahlwerke. So* I had an excellent opportunity to review both the river and harbor improvement practices in Europe, as well as the hydraulic laboratories. As I stated, I submitted frequent reports to the Chief's Office and to the ASME on these activities.

I was also taking courses at the *Technische Hochschule Charlottenburg* in connection with working for my degree as a doctor of engineering, and I was doing my research project at the *Prussiche Versuchsanstalt fur Wasserbau und Schiffbau.* I finally submitted a dissertation on *Geschieb Bewegung,* which means bedload movement in streams. That was the primary subject on which I was preparing my doctoral thesis.

But it was a very interesting period. Incidentally, that was the period that Hitler had just taken over power. He was developing the Nazi organization and the military buildup of Germany. I took every opportunity to observe those activities. For instance, in our hydraulic laboratory we had two sections. One concerned studies for river development, lock and dam controls and structures, etcetera, and the other one was the *Schiffbau Abteilung,* which embraced the ship model basins. At that time Germany was restricted to a little 10,000-ton battleship as the maximum it could have. It wasn't supposed to have too many submarines, large cruisers and so on, and no air force. But in any case, they were conducting model experiments of different type hulls, particularly of larger ones with aircraft earner potential, large battleships, cruisers, and new submarines. Even though I wasn't supposed to go into that, I always took a detour route to observe as much of that activity as possible.

I was observing what they were doing in connection with model studies for the ships and craft that they were investigating in connection with their proposed naval construction program. In addition to reports that I was sending to the Chief of Engineers and so on, I was submitting reports to our military attache. I was attached to the office of the military attache in the American embassy in Berlin, and I submitted reports on things that I thought were of military intelligence value, including that as well as observations on other matters.

At that time Germany was not authorized to have an air force—in fact, it was committed by the Versailles Treaty not to. Well, that was an impossible thing to do—to keep a major country, such as Germany, quiet not for 5 years, 10 years, 15 years, but from here on out. So naturally Germany was planning to do something about it, and Hitler was getting Germany aroused. On occasion we saw mass movements, sometimes of a million people, gathered in connection with these various celebrations. One thing they were doing was to carve out massive caves in some of the mountains. They then built aircraft assembly shops in these caves where they were not subject to observation. However, we knew an American girl who was married to a German. We were quite friendly with her then. We learned through her that he was engaged in this activity of building these aircraft even though, as I said, it was in violation of the Versailles Treaty. They were preparing this air force, which then consisted of their *Luftsport Flieger* (glider pilots), for ultimate service in avenging the Treaty of Versailles and getting Germany back to its proper state as a leading power.

Q: What were the conditions like in Germany at that time as far as the average person?

A: Conditions were quite different from what we had experienced in Koblenz at the end of World War I. Then we had seen a Germany that was down, and now we saw a Germany that was on the rise. Germany was restricted in many things, and they were then most active in the field of synthetics. They had to develop synthetic fuel because they had limited exports and there were critical foreign exchange problems, so it was required that anybody who used gasoline use this synthetic sort of gasohol-like fuel, and little of that for recreational use.

Many of the cars and trucks utilized charcoal for fuel, where they produced gas from the burning of charcoal in a contraption in the trunk. There was a tremendous amount of horse labor on the farms instead of the tractors that we used.

As I stated previously, they had the so-called *Luftsport Flieger*. The sons of some of the best families in Germany belonged to this. Germany had been restricted from having any air force, but what they did have was large numbers of gliders, and these young men, with beautiful uniforms the equivalent to what their air force would be, would be out and doing training exercises using these gliders. And that was sort of the basic development of their air force for as and when they later got planes.

It was interesting, too, to see the maneuvers that they were conducting. We lived in a beautiful little villa in Grunewald, Berlin, just across from that large forest. On Saturdays and Sundays the Nazi groups, which were organized similar to the divisions and corps that they had had in World War I—they had the same names and numbers—would conduct maneuvers. Here there were personnel without arms, with limited transportation, but you'd see them come up with a truck, and on that truck they had a papier mache or some other form simulating a tank, simulating guns on it, and they were conducting tactical exercises in the Grunewald with signal troops, going through a simulated military exercise.

Hitler also put through a blackout requirement, so that on certain occasions, when they said it was a blackout, each house could not have a light in the house that was visible from outside, so you had to provide a black shade to put over each window. You could have a light inside but have it not showing from the outside.

Germanywide, they had a restriction on cars that you had to blacken out the front headlights, except for a strip of let's say 4 or 5 millimeters wide and 6 or 7 centimeters long—they prescribed specifically what the size of these two slots were—letting out a slight glimmer of light, so in that way they could still carry on movement at night without being visible from the air.

This was, as I say, in 1933-35, four to six years before their World War II war broke out. They also required specified fire protection from air raids. For instance, in our villa we had an attic of so many square meters. We were required that, if there were so many square meters, you had to have a shovel or two, you had to have two or more buckets of sand, you had to have a bucket or more water. It depended on what the size was, and they would have inspections to see that you had your house so equipped against a potential air raid in order to control the fires. But when you think of the measures and preparations that they were taking then compared to the lack of preparation elsewhere, it was really remarkable to observe.

France, in the meantime, depending on the "impregnable" Maginot Line, knew that nothing could ever happen to them.

Q: What were your views of the effect of the Nazis and their ideology on the people of Berlin?

A: Hitler had started with a tiny minority, but they were a very disciplined group and they grew in extent and power, particularly down in Bavaria and in South Germany, but then they gradually expanded and ultimately became the dominant power throughout Germany, particularly after Hitler became chancellor. It was the practice previously, for example, when two German men met in the street, the junior would doff his hat to pass on a greeting, and the other man would then take his hat off. Well, during the Nazi regime the prescribed salutation was to raise the right arm and with a sign say *"Heil Hitler.* " If you had any correspondence, official correspondence, personal correspondence, or whatnot, you didn't end up with "very respectfully, " "respectful y yours, " or "sincerely." It was always *"Sieg heil"* or "Heil *Hitler.* " If you were on the telephone, instead of saying "hello," you said *"Heil Hitler.* " At the end of the conversation, it was *"Heil Hitler. " "Heil Hitler "*- It was generated throughout the country.

Now, that didn't mean that 100 percent were all for it, because you could sense opposition among some of those whom we knew intimately, particularly those in the upper classes. But the man on the street was adopting this thing. Hitler would frequently get on the radio—he was a terrific orator—and he would speak to the masses, inspiring them and saying that with his Nazi movement and program they could accomplish all these objectives. They could get food, they could correct the injustices over in Poland, where part of Germany had been taken. They wanted to get back to the Rhineland, which they had been prevented to arm. He was really a very dramatic orator. Some of the mass meetings they had were really spectacular, with the drums, banners, and the lighted torches they had. It was really a marvelous job of public relations where he was getting the whole country to go madly behind him.

As a matter of fact, when he first came into power he was doing an excellent job, because he cleaned up the streets. He eliminated a lot of the begging, except for those who had been badly disabled from wounds in World War I. He did much to improve Germany. Later on he got drunk with power and obsessed with his own personal power, and he went far and beyond where he should have gone. But in the initial phase he was doing very much good until he started persecution of the Jews, and that was just beginning when we left in 1935.

Q: Did you have a chance to talk to any German Army engineers while you were there?

A: No, not particularly German Army engineers. I met a number of the German officers in relatively high command at receptions that they had at the embassy. My contact, as I say, was with the German civilian engineering group, and particularly at the universities, the schools, those in hydraulic laboratories, and those concerned with civil works in Germany. I had quite a few contacts with them, but not particularly with any of the German military engineers.

Q: American engineers were heavily influenced by German engineering development. Why do you think this was so? Was it because they were so much more advanced?

A: Yes. Hydraulic laboratories, they were in the forefront, not just in Germany, but in Europe in general, but I think particularly in Germany. And they were also quite advanced, let's say, in theory. But I thought that the United States could adapt theory to practical application and construction to a better degree than they could, certainly as of that time. I don't recall, though, anything special in the way of German development. As I say, in the field of navigation structures they were well advanced in these major roller-dam units for a movable dam in place of the wicket type and bear traps and so on that we had been using. But I don't think that of itself would indicate in the whole field that they were superior.

Passamaquoddy Tidal Power Project

Q: Upon returning to the United States, you were surprised at your assignment as chief of the Engineering Division for the Passamaquoddy Tidal Power Project. Do you want to repeat that story?

A: Well, as I said, I had been sent over there primarily to be briefed and prepared to take over the hydraulic laboratory at Vicksburg, Mississippi, which we thought was very, very important to the Corps of Engineers in connection with future developments and research and improvements and so on. And so, knowing that we were going there, and noting that a lot of the German families were having difficulty with low wages and with economic conditions among the average public not at the best, we gave away all of the three children's winter clothing and some of our own, because, knowing we were going to be down in Mississippi, we wouldn't need them for a cold winter.

Well, when we got back to New York we were greeted by Lucius Clay, who had succeeded me in the Chief's Office in the Rivers and Harbors Section, and a Mr. Stout was with him. They greeted us as we got off the transport, and then congratulated us on my new assignment up at Passamaquoddy. He said, "You don't know about Passamaquoddy? Why, that's President Roosevelt's pet project." President Roosevelt had a summer home up in Campobello Island, and his next door neighbor was Dexter P. Cooper. Dexter P. Cooper had been living for years on the Passamaquoddy Tidal Power Project plan. He was always proposing it, and he had been getting funding from General Electric, Westinghouse, and the turbine manufacturers, and he was presenting a glowing picture of the potential in development of Passamaquoddy and had sold it to Franklin D. So Franklin D. directed the Corps of Engineers to build the project. I guess they figured that with the special research and so on I had done, coupled with my prior service on rivers and harbors work and other activities, maybe I was the one to go up to handle the engineering.

So we were sent up to Eastport, Maine, and I was put in charge of engineering the project. I might say that was the principal phase of the Passamaquoddy project. We did have Roy Lord on operations, and we built barracks and so on and quarters for the personnel as it was planned to be a rather long-term construction project. Phil Fleming was the district engineer. Phil was a wonderful guy, but he didn't know anything about hydraulics or power development or turbines or such. He was the administrative and executive head. So the complete engineering was my function.

I gathered up a number of well-qualified individuals for my division. At that time there was a depression in the engineering field and we were able to get some well-qualified engineers such as from Stone and Webster and organizations of that type. So I got an excellent group of hydraulic, mechanical, and electrical engineers, and we proceeded on with the design.

We were restricted just to Cobscook Bay, limiting us to a single basin project. It's absolutely economically infeasible to develop economic hydrotidal power from a single basin project. You build a dam to enclose this interior bay, with massive gates to open at high tide in order to bring the level of the interior bay up to high tide, and as it recedes, you close the gates. Then as the tide drops to about 5 1/2 feet below pool level you open up the powerhouse and generate power during the falling tide until the tide again rises to where you have only about a 5 1/2-foot head difference, and then you shut off the power. You then have to wait until the tide gets up to inner pool level when you open the gates and try to refill the pool [to replace] the water that you have used in power development, doing that in successive cycles.

That means intermittent power. It also doesn't mean that you get the peak power at a fixed time of day, because it conforms with the tidal cycle, which is on a lunar day rather than a normal solar day, so that means that you get maximum power at either the night or the morning or the afternoon. So because of that, for firm power you have to develop an auxiliary source of power. So we planned for a pumped storage project in the vicinity. When developing tidal power, we would be sending some power down to the pumped storage project, pumping water up to this high-head reservoir. When the tidal powerhouse would shut down, we would regenerate the power from the pumped storage power facility. But that meant duplication of structures and equipment, power losses, and so on.

Incidentally, we were also using salt water. With salt water you suffer from corrosion and from galvanic action. If, as you must, you have copper and steel, you are going to have the damaging effect of galvanic action.

Concrete structures would also be subject to alternate exposure to freezing at low tide and higher salt water pressure at high tide. So we were confronted with many, many problems. Now, if they ever are going to develop the Passamaquoddy Tidal Power Project, it should be an international project. We should have Canada come into this with Passamaquoddy Bay and the United States with its Cobscook Bay, and the powerhouse between them. With two pools, the high pool would be filled to high tide level. The lower pool would have its gates opened near low tide to bring it down to low tide level and then closed. In that way you would have continuous power and something approaching economic feasibility without an expensive auxiliary power source.

But you must keep in mind that these are low-head projects. If you have a low-head hydro plant, it means that for hydraulic efficiency you have massive turbines, massive generators, moving at relatively slow speed. And when they are massive, that means more steel, more copper, more concrete to support it, and much higher expense per unit, per kilowatt unit of capacity, in addition to the problems of galvanic action and corrosion with salt water. In connection with our research we set up both a hydraulic laboratory and a soils mechanics laboratory. We also had experiments conducted at Worcester Polytechnic Institute as to how you would build a dam in flowing water with swift tidal currents and great depths–making cofferdams impossible-and with poor foundations. We would have to place massive boulders in the face of swift tidal currents coming in and out. So it would have been a very, very difficult project. In fact, I presented a paper on that to the Permanent International Association of Navigation Congresses [PIANC] about the problems in connection with construction of a rock-fill dam in a flowing stream.

We also set up a laboratory testing combinations of metals-copper and others—and the corrective means to control galvanic action and corrosion, both in salt water and salt water atmosphere. We also set up a special concrete laboratory to test different types of cements, because the concrete structures were going to be subject to not only salt water but to intermittent wetting and drying and to extreme freezing conditions. I later submitted a paper to the American Concrete Institute on these studies.

So there were many, many technical problems that we covered and I reported on in my report. We reported that although it was feasible from an engineering and construction viewpoint, its cost ran out of sight. At that time energy costs were much lower than they are now. But also, we indicated that there were other potential normal hydroelectric power development possibilities in the state of Maine which should, in preference, be developed first, even though one of the primary purposes at that time was to relieve unemployment. That is what was happening there at Passamaquoddy because the labor that we used on all the construction work was WPA [Works Progress Administration] labor [that] was engaged primarily to relieve unemployment in that area.

Incidentally, those are some of the things not mentioned in this book you gave me, *Army Engineers in New England*, where there is quite a long discussion on Passamaquoddy, but these are some of the things not mentioned that quite possibly could have been brought in.

Q: In this project you had provisions, as you have mentioned, for pumped storage. This is used now quite frequently, but was it a relatively new technique for hydroelectric power generation in the 1930s?

A: It was a very new technique. They had had a few of them in Europe, but now it is used frequently in many, many areas. It is possible and advantageous for a large steam power generating station to operate 24 hours around the clock, producing power at high efficiency. However, the power loads that they are selling, that are used by industry and by households, occur intermittently. You run at peak hours where there are large demands for power, and then the power demand will lower and you will have long periods where the power demand for the total system is low.

What they can do is to build power plants large enough to hit the peak capacity load throughout the system, but that would be uneconomical. It is also uneconomical for a steam power station to generate power for so many hours near the peak loads and then shut down until required to build it up again. It is much more economical and efficient to run that steam power, a basic power plant, at full load, just steadily around the clock. But that generates excess power during the low power need period. Therefore it is desirable to store that excess for use during peak load periods. And the way they store it, instead of by storage batteries, is to provide a large reservoir site up at a high elevation with a penstock, motors, and pumps and pump the water up into reservoir storage, and then when you have increased load, you can call on that reserve, send it down to regenerate power at the power station, and in that way equalize your load production to the varying load requirements.

Q: Apparently this is not very well understood by the general public, as witnessed by the cancellation to the Dickey-Lincoln project, which was going to be in combination with another Passamaquoddy-type power project.

A: Yes, it is too bad, particularly now, with increased costs for power generation. Many of our power stations are dependent on fuel oil, and there is strong objection to additional steam-coal powered plants unless they can get the type of coal which is relatively free of smoke pollution. That is more expensive and more difficult to get, particularly in certain regions where it requires long shipment distances to get the best type of coal. But considering all of those factors, in any place where there is a potential for pumped storage development and where you have major power stations with varying power loads throughout the system, one of the more economical methods of handling that increased demand is through the use of a pumped storage facility.

Q: You were an active participant in this project, and it is obvious from your comments that you did not think the project as then outlined was economically feasible. Would you agree that the political forces prevailed upon Roosevelt to let the project die in 1936?

A: Yes. I mean, here we had a report indicating what the heavy and uneconomical costs were. There were opponents as well as proponents to this development. The power interests in New England were not interested in having the federal government coming into the power generation field, particularly in a new area. As far as I was concerned, I would have opposed it if the government tried to sell such power direct to customers in the market area. I would favor selling this power to existing power companies to use in their distribution system, which is what we did later on in the Philippines when I built the Caliraya Project near Manila.

The attitude among Filipinos was that the government should not only generate the power but also sell it directly to the public. I strongly opposed that and said that we should generate the power at low cost because of tax-exempt government financing, especially with the hydropower costs high in capital cost but very low in maintenance and operation. If you can get government money at low interest, as compared to the high interest rates that private industry would have to pay, you can generate the power at a lower cost. But the best way to sell the power, rather than through duplicate and competing distribution facilities, is to utilize existing private utilities, selling the power in bulk to them at a rate that ensures a profit to you, and you control by regulation the rates that they sell in their system. That certainly is a more effective and better way to handle such power.

Q: That would be quite similar to the way that they do it out at Bonneville now, where they sell it to the Bonneville Power Administration. Do you believe that the Corps of Engineers gained any positive results from the Passamaquoddy project?

A: Oh, I think not. I mean, in world literature they are cognizant of it, and there have been studies made and so on. But as far as Maine is concerned, and the area up there, they are all disappointed that the government did not proceed to relieve unemployment there and to provide this power source and stimulate further industry up there.

But it is interesting, though, that just before any national election for the President or the Congress and Senate, you will see those who are about to run for office get a little resolution through the Rivers and Harbors Committee of the House or Commerce Committee of the Senate calling for a review of the project that we submitted, which is very easy to get. They then send it down to the Chief of Engineers, and we have to go in and review the project and so on, and the congressman hopes the review, which is destined to be adverse, is going to take longer than the time until election. But anyway, he has done his duty. He is trying to get this thing for his constituents, and that "damn" Corps of Engineers doesn't come up and give a recommendation for approval of the project for something that is economically unfeasible.

As I say, if you ever want to get back into the Passamaquoddy and its development, you have to go the international route and have Canada and the United States join in a two-basin project, which might, depending on studies, approach feasibility.

Q: Were there any technical achievements that were made under your direction in the studies of salt water effects, corrosion, concrete research?

A: Yes. As I say, we had extensive investigations in our concrete laboratory. Incidentally, Mr. Wurpel was our civilian engineer on our concrete lab studies. We tested different combinations of various types of cement and mixtures and so on, and came out with a rather extensive report. In fact, I gave a paper on it to the American Concrete Institute. (See Appendix E.) We came out with a recommendation as to the type of cement that we felt could best resist the many forces that concrete would be subject to up there—salt water, intermittent wetting and drying daily, getting wet under high hydraulic pressure and then drying out as the tide recedes. And then you have freezing weather, which is very harsh particularly on alternately wetting and drying concrete. We also, as I say, had problems with galvanic action. We were going to have copper and steel and other metals subject to salt water air as well as being immersed in salt water, or intermittently with the rising and falling tides. We made rather extensive studies with different types of metals, developing different measures to protect the metal, including use of zinc in connection with varying amounts of copper and steel. We set up quite a laboratory there. And those studies continued for quite some time, I know, after Passamaquoddy was terminated.

As I believe I stated previously, we also made extensive hydraulic laboratory studies down at Worcester Polytechnic as to the problems we'd have in building this dam under the swift flow of water in and out during construction of the dam. It would be impossible to build a cofferdam in these great depths and swift currents. You had to build it by dropping major size rocks and boulders to form the structure of the dam. With the swift tidal currents, you had to determine the sizes of rock that would resist being washed out. The upper layers of such structures would have to be placed during the limited slack water periods near changes of tide and at low tide for the uppermost protective layers.

We also had a relatively low head development, so we made extensive studies of different types of turbines and also the tailraces for maximum hydraulic efficiency. We had excellent studies of those, also conducted down at the Worcester Polytechnic, under Professor C. T. Allen, who was head of the laboratory at that time. Those, I think, were additional dividends in connection with our research. It was done in connection with the design of this quite different project.

Q: Yesterday you spoke of Sam Sturgis' part in Passamaquoddy. What about Roy Lord and his role as the chief of the Operations Division?

A: Royal was chief of operations. If the project had proceeded, and we were going into construction, and if he were still going to remain as chief of that, his would have been a rather major responsibility. But during the survey phase the principal thing we were doing was in engineering; the development of plans, specifications, cost estimates, and so on for it. As chief of operations, his function then was solely to supervise the construction of the quarters that we required for the personnel. We had to provide a rather sizable village community to take care of the personnel that we had and which we would require during the construction phase. That was principally the function that Lord had at that time, supervision of that construction. Oh, we did fill in two small railroad bridges where we were going to enclose the pool, and we did provide some rock-fill around those, and the Operations Division supervised that.

Q: What about Roy Lord, as a person?

A: Roy was a very positive person. He was held in very high regard by Phil Fleming as he later on went with Phil Fleming, I think, when Phil had the Public Works Administration. But Roy was a bit brash and direct. Roy wasn't too popular among a lot of the Corps. Later on his principal role was when he served in Europe, I think, as deputy or assistant to General Lee [Lieutenant General John C. H. Lee] in connection with the Services of Supply [European Theater of Operations, US Army, ETOUSA]. I have heard stones about his actions and service over there, but it's best to get those views directly.

Boston Engineer District

Q: When the Passamaquoddy project was shut down in 1936, you were transferred to the Flood Control Division of the Boston Engineer District. Did you have any choice in this assignment?

A: No. I had finished the engineering studies and submitted our report, but in 1936 we had a major flood through New England and through the Pittsburgh area. As I say, I had put in my report in 1928 on the Pittsburgh flood control, on the Allegheny and Monongahela rivers. The ‘ 36 flood came right in on the button as to the type and extent of flood I had projected. So the Chief’s Office-I guess they got out the report-saw that here was this special investigation of flood control; so they figured that Pat Casey was the boy to be sent down to take charge of the New England flood studies, because New England had also been subject to flood and devastation in their area, just as they had been in the Pittsburgh area.

So I was sent down, not by request but by orders from the Chief’s Office, to report to the Boston District. Colonel A.K.B. Lyman was the district engineer, so I reported to him and was put in charge of the flood control investigation. I got a few of our principal engineers from Passamaquoddy, particularly those who had been involved in hydraulics and in some of the structures, and so I built up a nucleus of civilian civil engineers in connection with that project.

Then we conducted a number of surveys for potential reservoir sites throughout the principal New England streams. We also embarked on the construction of the Franklin Falls Dam for flood control on the upper Connecticut River. WPA money was available at that time. We had had some concentrated flood damage down in the city of Fitchburg, Massachusetts, and also at Haverhill; relatively minor projects. We investigated them and found that we could afford relief by some corrective works at each locality; building a river wall at Haverhill and doing some river rectification and construction of some small reservoirs at Fitchburg. We proceeded with those projects with WPA funds and personnel. Those were two small flood control projects that we completed, and the rest of our investigation, other than the Franklin Falls Dam, was in studies that we were making on major flood control on the principal tributaries of the New England rivers in Maine, New Hampshire, and Vermont.

Q: All this work in response to the Flood Control Act of 1936 was very significant. How much state and local cooperation did you get? Did they all provide you with the state and local compacts? The Connecticut River was a real problem because it went through Connecticut, Massachusetts, New Hampshire, and Vermont.

A: Well, as I recall now, I don't think we got any direct assistance. If we wanted to get some hydrographic information from agencies, why we'd get that, but we did not have any direct assistance from these communities. However, if we were going to build a project, why there probably would have been some recommendations that we proceed with this if the local interests provide some rights-of-way such as they do for spoil areas for dredging. But in the major projects I don't think that would have been contemplated, because one of the major costs in constructing some of these dams would be the relocation of a railroad.

It just so happens that the best flood reservoir possibilities are in the valleys, and the valleys are where you have industrial and agricultural development. You'll have roads there because it is an easy route of access and you'll have railroads there. So if you are going to build a dam, why, you not only have to relocate the roads in the reservoir area itself, but you have to relocate them almost in an equal distance downstream in order to get it up to above dam elevation. Railroad relocation and road relocation are quite difficult and quite expensive, and taking over lands and developments and relocating communities are also major problems. I notice in other similar reports that have gone in there is a tremendous amount of local opposition on the part of some of the people who are being displaced by the construction of such reservoirs.

Q: Did you notice any distinct break between the urban and the rural populations and the political forces in New England on flood control work?

A: No, certainly not at that time. As I say, during the period I was there it was just during a period of investigations and preparation of reports, and other than, let's say, Fitchburg and Haverhill, where we got full cooperation from the community because they were minor projects, they were not going to be disrupted too much, and they were going to benefit materially, those specific areas. They were heartily in support of us, and we got strong support from them. But if we had proceeded with maybe some of the larger flood control reservoirs which would require major dislocations or taking of property, I don't know what the attitude would have been, because I wasn't there and I had left before those studies where completed.

Q: Were you at all involved in designing some of the early flood control projects in New England that provided penstocks for potential conversion to hydropower facilities?

A: I am trying to think whether or not in Franklin Falls we did that or not. I know we had contemplated it in connection with any major structures that we were planning to build. You must keep in mind that at that time we had the advantage of the stock of 308 surveys. We knew that it was policy to utilize the basic resources of a stream not just for flood control purposes alone, but that it was possible to get other added benefits from it in the way of a potential lake or as resort potential. And particularly if there were any possibilities for hydropower, why, we certainly wanted to consider such potential and make provision for it.

Q: Were you at all involved in the work being done on the Cape Cod Canal?

A: Yes. However, my primary function was on this flood control work, and I was doing a lot of work in the field. I was also involved with some matters on the Cape Cod Canal, but only in a minor way because no major changes were under way at that time. I do recall one time that Colonel Lyman had me go down when they were having some problems with the paving on the bridges, and so we had to work out corrective measures for that. But there were no important plans nor major work under way other than operation and maintenance activities on the canal at that time.

Q: What major engineering and managerial lessons could you say you learned from your tour with the Boston District?

A: None other than possibly sort of a continuation of the flood control investigations and work I had done initially up at the Pittsburgh District. I don't know of anything novel or new other than some experience working with WPA people on some of our projects. There we utilized requisition labor and by direct management did some minor engineering works, which maybe to them were considered major but actually were relatively small—some river regulation and small reservoirs at Fitchburg and a flood wall at Haverhill, both in Massachusetts.

Philippine Islands

Q: In October 1937 you went to the Philippines as adviser on engineering projects for hydropower and flood control. Were you asked to accept this duty because of your experience in both hydropower and flood control?

A: President [Manual] Quezon and General [Douglas] MacArthur made a trip to the United States shortly before then, and General MacArthur, being a Corps of Engineers officer, decided that for this work he thought it would be best to get two Corps of Engineers officers. So he contacted the Chief of Engineers' Office. [Major] General [Edward] Markham was Chief at that time, while Lucius Clay was at my former job at the Rivers and Harbors desk. I assume they had a conference there, and they recommended that Lucius Clay and I be sent. Lucius then contacted me. He said that they wanted me by reason of my Passamaquoddy experience and study and research over in Europe and whatnot, and asked if I'd be willing to go too. So I contacted Dorothy, who agreed. As a result, Lucius Clay and I were ordered over there. It wasn't because of any request that we made, but it was because of General MacArthur's and President Quezon's request that two Corps of Engineers officers be assigned, and we were the two that were sent.

We both left with our families, leaving by Army transport from New York, so it wasn't a major rush operation because it took us, I guess, 40-odd days from New York to go all the way around through the Panama Canal up the Pacific Coast and then on over ultimately to Manila. But we had a very enjoyable trip, with both families together on the transport.

Q: What was the nature of the work you were to undertake in the Philippines?

A: The Philippines were due to have their independence in some few years. With an independent country, it is essential that they develop their own basic resources and try to do everything they can within the country to reduce their external demands for things that call for foreign exchange. You try to balance your import-export to attain a stable currency. If your demands for items outside of the country are far in excess of your economic capacity to pay, you're in trouble.

So it was desirable, therefore, to develop the hydroelectric sources in the Philippines to the maximum extent because oil was expensive (though relatively cheap compared to the present) and they did not have a source of oil or coal. All that had to be imported, so it was therefore important to develop to the maximum the hydroelectric power potential of the Philippines.

Q: What projects were you assigned to undertake?

A: We were assigned no projects. We were just given a blank check. Lucius and I got such maps as were available, geological survey maps, although they were limited and not to large scale. We also assembled all available hydrographic data. We made a general analysis of the situation. We found out what the current power sources were, principally MERALCO, the Manila Electric Company, that controlled the principal power generation and distribution, particularly in the metropolitan Manila area. There were also some small power companies scattered through the Philippines which consisted largely of small diesel electric units and the diesel power units that the principal mining companies had. Then, based on the map study, we sought out the potential waterpower sources, then made extensive field investigations.

Lucius and I probably covered on foot more of the Philippines than certainly any other American and more so, I think, than most Filipinos. We reconnoitered the Agno River from its source down to its mouth, wading down through a stream which was subject to sudden, very high flooding in the narrow gorges, sort of a risky procedure. We started out with a raft but the raft broke up after several trips through the rapids. We had *cargedores*, native carriers who carried our supplies. We'd have maybe 15 or 20 Filipinos carrying our supplies and provisions. En route we'd make notes of potential dam and power sites and such.

We made a similar survey of the Agus River up in the northeast, from its headwaters down to its mouth. We covered a number of the small streams in the central Philippines. They had minor potentials. We made extensive studies down in Mindanao and particularly on the Lake Lanao potential. There in Mindanao they have this huge lake several thousand feet above sea level and only 5 or 6 miles from the sea, with the major fall concentrated in two series of rapids. We saw there was a wonderful possibility of building a relatively small dam providing a vast reservoir area for each foot of dam elevation, offering millions of acre feet of potential storage. With this concentration of fall, you could build a large powerhouse below the first rapids and then another series of penstocks and powerhouses down below. That project could have developed the cheapest large-scale hydropower that you could imagine most anywhere, because the dams and the structures were relatively inexpensive in comparison with their potential output. It also provided firm, dependable power because of the excellent source of rainfall and the wonderful opportunity to equalize the flow due to the large reservoir capacity on the lake. But you had no market. The existing market then was about 50 kilowatts at Dansalen and 50 kilowatts at Illigan. So if you turned out a million kilowatts of power, why you had a problem with what you could do with it.

We did foresee that in the future there was a great mining potential down there in Mindanao as well as a vast agricultural and industrial potential. Since then, based on our preliminary plans, it has been developed and is very, very successful. Anyway, we prepared preliminary plans for such developments in Mindanao, Luzon, and elsewhere, with rather detailed plans on the Agno River.

We wanted to make sure that the first project we built would be a highly successful one. If we went into something and it flopped or it cost far more than anticipated or it didn't function economically, why that would be the end of the National Power Corporation.

The government had set up this National Power Corporation and we were the engineer advisers to it, making the engineering development studies. Lucius, however, wasn't sort of a hundred percent behind the idea of development by the government. I think his views were more in connection with preparing plans for development by private utilities. He wasn't directly against it, but he wasn't as enthused over that as much as I. In any case, after our first year, his son Lou had just flunked out from West Point and had been turned back to the next class; and his other son, Frank, was then seeking an appointment to West Point. Lucius had had many contacts with congressmen and senators, so he decided he wanted to go back and try to see about getting the youngsters back to the Point. So he left and was soon assigned as district engineer on the Dennison Dam—a major power project which he handled very successfully.

At any rate, for the next two years I continued on and finished up the plans for this first project on the Caliraya in addition to the other investigations. There we planned to dam up the Caliraya River at its outlet from a large flat plateau area providing large reservoir storage. The dam was over 100 feet high. We designed it as an earth dam from which we constructed a diversion canal several miles to the head of a steep slope about 950 feet above the lower bay level. We constructed a large surge stock and penstock down to the powerhouse below, with a tailrace to the bay. The high head permitted the use of high-speed turbines and generators at relatively low unit costs. I prepared the basic plans and estimated the cost at $5 million, or 10 million pesos, for this 40,000 horsepower project.

My office was in General MacArthur's headquarters, but neither he nor Lieutenant Colonel Dwight D. Eisenhower, who was chief of staff, had any particular interest in our hydroelectric engineering phase. Their concern with us was mainly with our relations with the Corps of Engineers of the Philippines Army, whom we were also training.

So we were going along independently on the power study phase. But when it came time to submit this initial power project report, President Quezon called on General MacArthur for its submission. So Ike Eisenhower and I and Mr. Rodriquez of the National Power Corporation proceeded to Malacanaan and I made the presentation. Quezon asked a number of questions, while Ike was just present listening. Anyway, Quezon, before I was even through, said, "Fine, we'll build it. " So that was the authorization for the first hydroelectric project in the Philippines and the successful start of the National Power Corporation.

Then we went in and proceeded to build it. We did not advertise for a bid for a general contractor to do everything, requiring getting one from the States, but for economy reasons we decided to do it almost piecemeal. We had one contractor building the dam, another one building the structures, another one on the pen stocks. We received low bids for the turbines from Pelton Water Wheel, from General Electric on the generators and the 50-mile transmission line to Manila, and from Westinghouse on the transformers.

We also had bids from Hitachi, a Japanese firm. It's a big firm, and they bid on the generators, transformers, and turbines. When their bid came in, they were almost 40 percent below the low bid from the American equipment manufacturers. But we had a provision in the Commonwealth law that a foreign manufacturer was subject to certain percentage penalties in evaluating his bid. For example, bids on foreign equipment were subject to a 15 percent incremental penalty with an additional 15 percent if from a foreign supplier. And then there was an exchange differential, which was about another 15 percent. So as a result I strongly recommended that we not take the Hitachi equipment, even though lower in cost. If we had, as war broke out later, we would have had untold problems.

The local Philippines construction contractors lacked any heavy earth-moving equipment, so in order to afford them an opportunity to bid, we purchased a quantity of bulldozers and carryalls indicating in our bids that it would be made available to the successful bidder, thereby increasing local competition and reducing costs.

I might add that I set up the first hydraulic laboratory and the first soils mechanics laboratory in the Philippines for model studies and control. I was the sole American engineer on the project, utilizing all Philippine personnel.

But anyway, we proceeded with it and finished the project, building it within the bond issue, which was ultimately paid off. The project was most successful and created a firm foundation for the National Power Corporation. The attitude of the Filipinos was that with the government producing the power, they should also go into direct distribution to the public. At that time MERALCO had all their distribution lines throughout Manila, and we were building the transmission line from our plant to Manila, to a large transformer substation there.

I strongly advocated that we sell our power by contract to MERALCO under controlled prices, giving us an assured and profitable market, avoiding wasteful construction of duplicate distribution lines. Furthermore, with government distribution the politicos would be prone to demand that power be brought to their various localities even at an uneconomic cost. We required that MERALCO take a specified amount of output at a high-capacity charge, assuring a specified profitable annual payment. We also set a low energy charge, thereby ensuring that they would use this power rather than their higher cost fuel-generated energy. And we could also control their rates. But anyway, it was a very successful operation.

Concurrently, we prepared preliminary plans on other streams such as the Agno, the Agus, a major development in Mindanao, and later on, after the war, the National Power Corporation got back into business developing these projects on the Agno, on the Agus, Lake Lanao in Mindanao. It has all been a very, very successful operation since.

Incidentally, President [Ferdinand] Marcos, the last time I went back, in 1972 as a guest of the Philippines Government on their 30th anniversary of the fall of Bataan and Corregidor, wanted me to return as a consultant. He called me the "Father of water power development in the Philippines. " They dangled a very enticing contract, with a handsome retainer plus rather high compensation for any work in my office up in Vermont or down in Florida. I could travel with Dorothy, first class, anytime we had to go to Washington, the Philippines, Japan, or elsewhere incident to funding, engineering, or equipment. But Dorothy and I decided I had been out of action too long, and we were going to enjoy our retirement. So I thanked them very much. At various ceremonies they also presented me with one of their highest decorations, plus other awards and plaques, for both my national power and subsequent military service as General MacArthur's chief engineer.

Q: What did you think of the Philippines when you got there?

A: The Philippines in 1937 was relatively underdeveloped. Copra and sugar and some gold mining were the major industries. In agriculture they used only *carabaos*, hand tools, with the natives working the fields. They did not have any heavy agricultural equipment.

One of the principal industries was the mining industry up in the Baguio area, in certain sections of the northeastern part of Mindanao, and some areas in the central Philippines. So I did make contact with them because they were potential power users. They were all developing their power from diesel electric plants. When we were investigating the potential power development areas, we also were making studies of potential power markets. So we would try to find out what the requirements were for existing industry, and what potential industries might come in and be developed with a cheap source of power. But the Philippines was a pleasant place to live.

Unfortunately, insofar as preparation for war is concerned, I regretted that the military section of our staff operated on only a half-day basis. They would start in the morning and maybe shortly after 1:00 P.M. they'd leave for lunch, with their afternoon free for golf, polo, or whatnot.

Lucius Clay and I had our office also at 1 Cane Victoria, General MacArthur's office as military adviser to the Commonwealth. The general wouldn't come in until about ten or so in the morning, and he'd be there until maybe about one to two. Then he went off and that was the last you saw of him. He'd have lunch and then a siesta.

General MacArthur's Manila headquarters at 1 Cane Victoria, late 1939. From left: Lieutenant S. L. Huff (aide and naval advisor), Major William F. Marquat (antiaircraft officer), Lieutenant Colonel Richard J. Marshall (deputy chief of staff), General Douglas MacArthur (military advisor to Philippine Commonwealth), Lieutenant Colonel Richard K. Sutherland (chief of staff), Major Hugh J. Casey (engineer advisor to Philippine Commonwealth), Major William Dunckal (staff officer).

Ike Eisenhower and the others on the staff would be there in the morning until General MacArthur left, and then they were off for the afternoon. So in the afternoon, Lucius and I (and then later, after he left for the States, only I) were the only ones working throughout the day in this headquarters because the military group had done their job and left.

In addition to the power development function, which was our principal assignment, we were also given the mission of supervising the training of the Philippine Army Corps of Engineers. We got to know all the principal officers of the Philippine Army Corps of Engineers, which was most helpful to me later as Chief Engineer, GHQ, when war broke.

There was a great need for mapping in the Philippines, particularly for our hydroelectric studies. We worked closely with our staff air adviser, who was working with the Philippine Air Corps, and got him to take us on numerous aerial missions over potential power sites, which we later on covered on foot through rugged mountain and jungle areas.

Appreciating the need for maps, I set up a procurement program for aerial photographic mapping equipment, cameras, and equipment to develop maps from the aerial photography. We also trained the Philippine Army engineers on their use, initiating their aerial mapping function.

Most of the rivers with potential hydropower development had very deficient hydrographic data as to their discharges. So we set up hydrographic stations at critical points on these principal streams in order to get a continuing record of flow as a basis for determining the power potential, such as the mean flow, as well as the high and low flows.

Q: Had you ever met MacArthur prior to your assignment to the Philippines?

A: No, not until then. Nor had Lucius Clay.

Q: What were your impressions of him?

A: I had a very favorable impression. He was erect, dignified, and very articulate. When we went in, he had us sit down while he walked back and forth briefing us generally on what the overall situation was. He expected that we would take care of the plans and studies for potential hydroelectric power development as well as supervise the training and development of the Corps of Engineers section of the developing Philippine Army.

He said, that's your mission. Now, from here on you're on your own. He said, you have no specified hours; you do not have to come to me; we're not going to tell you how to do it or what to do. That is your function, that is your responsibility and so on. However, in case there's some special problem on which you need special assistance, why feel free to come in. In 10 or 15 minutes we had had a very pleasant meeting and that was our assignment. In other words, he delegated the whole thing to us.

Q: So you must have worked more closely with Dwight Eisenhower?

A: Yes, but not particularly, except in connection with the Philippine Army activities. I' m talking now of that early phase, because our primary job was the hydroelectric power survey and development program. The remainder of the staff were a group apart, concerned with the development of the Philippine Army. They developed training programs, sought appropriations of funds, which unfortunately were being cut back and cut back, and endeavored to get arms, munitions, and equipment from the American forces and the government. However, I felt that the military staff was not doing quite as much as I felt they should be doing. Certainly, if I had been in there I think I'd have been much more active and working more on the problems that they had.

Q: What were your impressions of Eisenhower at that time?

A: We liked Ike very much. He had a very nice personality. His attitude toward Lucius and me was excellent. Even though MacArthur and Eisenhower didn't know much of anything about what we were doing in our civil work, nonetheless they had to prepare our military efficiency reports. I was startled one day, this was after Lucius had left and I had made my presentation to President Quezon about the Caliraya project and had embarked on it, when he called me in after he had prepared my efficiency report. He said, "Pat, I want you to see it, " and then said, "that's the best efficiency report I've written on any officer in my command. " So apparently I stood very well with Ike.

Ike was well liked by all of those there. I think it was after [Richard K.] Sutherland (then a major) joined us you could sense that Sutherland, who appeared to be a very ambitious person, seemed to be undercutting Ike. You could sort of sense that he wanted to get closer and closer to General MacArthur than through Eisenhower, seeking to replace Ike as chief of staff. It was then that you sensed a little coolness developing between General MacArthur and Ike.

There was no abrupt break, such as inferred by rumors, but I think Ike felt that maybe there would be a better opportunity for him back in the States, in case things developed world war-wise, such as with the War Department or on some command assignment rather than continuing on with MacArthur as his chief of staff.

Q: Was that because the position there as MacArthur's chief of staff really wasn't in the Army; it was sort of a strange position?

A: As we've said, General MacArthur was military adviser. He had no command over the Philippine Army. They did make him a marshal of the Philippine Army, but he did not exercise direct command. They did call the various Philippine Army general officers and their chiefs of staff in for conferences, but primarily on administrative, equipment, and training matters.

I felt that General MacArthur and some of the others should have gotten out more into the field with the Philippine Army units in connection with their training or observation and so on. It seemed that our staff did most of their activities just there in the office with administrative problems in connection with getting funds and getting equipment and matters like that.

Q: Speaking of administrative problems, what were the relations between MacArthur's staff and the Philippine Department commander's staff like?

A: We were two independent entities. The department commander commanded all of the American troops, including the Philippine Division at Fort McKinley, but we were a group apart.

We had friendly relationships, but did not have the close contact that I think they should have had. The Army did have its defense plan, the so-called "Orange Plan." General MacArthur decided that they should work up a new defense plan involving the developing Philippine Army, but I didn't think they made too much progress on it. It was still being developed at the time that war broke. He had developed a program to organize, train, and develop ten Philippine Army divisions each year. We were going to get 10,000 men each year for six months' service that would be trained and then they would go into the reserve. And then the next year get ten more divisions, and so on, building up to a force of one million in ten years, less attrition.

But you didn't have tanks, you didn't have artillery, you didn't have machine guns, you didn't have heavy equipment, and little transport. The engineer units didn't have anything much more than hand tools. You had a division made up mainly of manpower. Their hand weapons were Enfield rifles which had been discarded as surplus after World War I, and they were big, heavy weapons for small Philippine soldiers.

They also had serious funding problems because, I don't recall exactly what it was, it may have been 30 million pesos a year, and then President Quezon cut it back to as little as maybe 10 million pesos a year. I know there was a drastic reduction in the national defense appropriations, and MacArthur opposed that and felt that they needed much more, and they actually did need more. They were also trying to develop the Philippine Air Force, as well as a small Philippine Navy composed of small PT (patrol torpedo) boats. But the task was just so far beyond the money potential or other potentials that it was almost impossible.

In any case, MacArthur was developing this thesis of stopping the invasion troops at the beaches. He was going to hold them there. And when you consider all of the coastline of the Philippines and the limited personnel and limited equipment that they'd have or would have, even at the end of ten years after you supposedly had a million trained people, less attrition, it still seemed to me as an impossible goal. It looked like a hopeless task to try to develop the Philippine Army, Air Force, and Navy contingent capable of withstanding a major enemy attack and holding them at the beaches.

Q: So you wouldn't say that by the time you left the Philippines in 1940 the Philippine Army was any more able to defend themselves than it had been when you first went there?

A: Well, you had trained, to a degree, ten such divisions. I think the ones that had the best training-and I'm not saying it because I was associated with it, because there were reasons other than that—but I felt the best units in the Philippine forces were the Philippine engineer units.

Now the reason was that Philippine engineer unit officers were basically all engineer school graduates. They had gone to the university; they were engineer-trained, so they were generally educated and technical. Whereas many of the officers in the infantry and so on in the other Philippine units were sort of run-of-the-mill Filipinos, some political appointees, and as a group were not nearly as well qualified as were the Philippine Army engineer officers.

Shortly before the war broke out we called the Philippine engineer regiments into active duty about a month before they mobilized the divisions. That was because we were using the Philippine engineer troops on construction, preparing the cantonments, roads, water supply and utilities for the cantonments where the divisions were going to be located. So the engineer units did have some active duty under their commanders when the war broke, having been on active duty for a month or so, whereas all the rest of the Philippine Army were mobilized just about a week before the war broke. And they had not had staff experience or other exercises as tactical units. The Philippine Army division was not an able, tactical unit, and it was going to have and did have great difficulties in combat against the trained, aggressive, and well-equipped Japanese Arm y.

Q: Apparently the War Department was reluctant to spend money to improve the defenses of the islands or to provide the forces necessary to defend the islands because the Philippines were going to obtain their independence in the middle of the 1940s. From your experience, do you believe that was true?

A: Oh, absolutely, and mainly due to their impending release from US control into independence. First of all, we were getting hardly anything for several years before the war broke. It wasn't until shortly before the outbreak of the war, several months or so, when they recalled General MacArthur to active duty with a program to reinforce and strengthen our defenses. He had been military adviser to the Philippines, and they then appointed him commanding general of the US Army Forces Far East (USAFFE). That was an indication that here we were finally getting ready to develop a joint force to defend the Philippines.

They finally started giving approval to some of our requirements for signal installations, such as radar, and approval for additional artillery, some tanks, and they started to send additional units and equipment to complement our forces. But at the outbreak of war, our only US engineer units were the 803d Engineer Aviation Battalion, an engineer supply company, and the Philippine Scout combat engineer unit that was with the US Army Philippine Division, the Philippine Scouts.

And then one of the unfortunate things was, just shortly before the outbreak of war, the War Department decided that the engineer component of a division should be reduced from a regiment to a battalion. It worked in one way favorably for us in that we had a number of Philippine Scout engineer units providing a nucleus of some trained key Scout personnel with the various Philippine Army engineer units. And they were badly needed.

The Philippine Scout division as a whole was excellent, and the engineer battalion that was with it also was outstanding. One of the other American units we had was a small tank unit, as well as a cavalry unit. They were to be the last ones to engage in a cavalry action in any American war.

All the Philippine units lacked transportation. When the war broke we requisitioned or commandeered buses, we commandeered trucks, cars, almost anything in order to supplement or provide some of the basic essentials for these units.

Q: Did you have any familiarity during your time as adviser to MacArthur with the War Department planning that was going on for the defense of the Philippines, such as the war plan Orange 3?

A: Not particularly. I mean, I wasn't called in on it and wasn't other than vaguely familiar with it because—1 don 't know whether they were keeping it hush-hush or because during 1937-40 I was primarily busy with our civil work activities. When I got back in October 1941 that plan was being developed. And by the time I got back in October, just shortly before the outbreak of war, whatever they had been doing had been done or was in the process of being completed at that time.

Q: What were your opinions of MacArthur's other advisers, such as Sutherland?

A: Sutherland had a difficult task as chief of staff for MacArthur. MacArthur was not one who would call in his commanders and other subordinates to issue his instructions but routinely did so through his chief of staff. The chief of staff was the medium through whom communications went and so on. MacArthur had difficult hours, from sort of late in the morning and then a siesta in the afternoon. This was before the war broke out.

MacArthur had a brilliant mind and a fantastic memory. He could get a cable or telegram, look at it, put it down, and it was just as though he had made a photographic image of that thing in his mind. Just as though he had taken an Instamatic camera and recorded it, because he would walk up and down and could refer to the specific paragraphs and words in its content.

And intuitively he could come to a decision. Usually when you're deciding on a problem, you try to figure out the advantages, the disadvantages, and so on before you come to a decision as to what to do. But he had sort of an instinct of analyzing these factors, and with an almost computer-like brain, and could make a hasty decision which usually was correct.

Sutherland, as chief of staff, was not liked by many of the commanders because he could be sort of gruff and terse in his transmission of instructions. Some of the commanders who outranked him were not particularly fond of him. But I think he did a good job as chief of staff under the conditions that prevailed. He ran into some personal problems later, but those were personal problems.

Q: Did MacArthur ever talk to you about his time in the Corps of Engineers?

A: Never that I recall.

Q: Did he indicate at all that he believed that a war with Japan was inevitable?

A: Oh, I think he strongly sensed that. You sensed that in his discussions. And I think he was irritated over the lack of a similar feeling on the part of the War Department and the Washington administration to recognize that fact.

Q: What was life like for an Army family in the Philippines in the late 1930s?

A: It was a very comfortable life for the American family, both civil and military. Servants were plentiful and available at low cost. We had a chauffeur, a laundress, two houseboys, and gardener, and all for less than what one servant would cost over here.

Food was relatively cheap and ample. Some things were a little difficult to get, but by and large it was very pleasant. The officers club was superb. Horses were available for equitation, and Fort McKinley had a fine golf course, with caddies, mostly girl natives, available at 50 cents (1 peso) for 18 holes.

Q: Who were some of your Army acquaintances in the Philippines?

A: In the Philippines? Well, Lucius Clay, my former West Point roommate, was there with me for the first year. We also had other classmates. Captain Leland Hewitt, who later during the war served with our Far East Air Force as air engineer of that command. Lloyd Mielenz was on duty as deputy to Colonel [Henry H.] Stickney, the Philippine Department engineer. And then we met other friends of other branches. [Major] General [George] Grunert was there as Philippine Department commander of the US forces. And a number of others whose names I can’t recall right now.

Office of the Quartermaster General and the National Defense Construction Program

Q: In October 1940 you returned to the United States and were assigned to the 10th Engineer Battalion at Fort Lewis, Washington. Why did you receive this assignment, and what were your duties at Fort Lewis?

A: Actually, I never did serve there, and not at my request, but by direction of the War Department. I had orders to go to Fort Lewis, Washington. Most of our furniture we had left in storage up in Boston before we went to the Philippines. Believing in advanced planning, when I was ordered to Fort Lewis I cabled and had our furniture shipped from the East Coast around through the Panama Canal. On our departure our other furniture from the Philippines was also shipped, headed toward Fort Lewis.

I had a short leave after arrival in the United States, and on that leave I was doing some work for the National Power Corporation in continuation of the work that I had been doing, checking on electrical equipment that had been ordered through General Electric and Westinghouse and also conferring with the Pelton Water Wheel Company, turbine manufacturers, in San Francisco. Also during that time I bought a car, ordered it in St. Louis through a friend who was with General Motors, and shipped it on to the West Coast so that Mrs. Casey would have it.

During all of this they suddenly issued orders ordering me to proceed to Washington to report to the office of General Somervell on the National Defense Construction Program. Dorothy, in the meantime, had proceeded up to Seattle and arranged to enroll our daughter at the University [of Washington] there when she got word that our orders were changed, transferring me to Washington. As a result I never did actually serve with the 3d Division.

At that time Eisenhower was on duty with the 3d Division. If I had not had my orders changed and had served there, I probably would have been associated with Ike subsequently in the war that later occurred.

But it did cost us a lot of money because of the excess freight on our household effects shipped clear around the country through the Panama Canal, and then again having it shipped back to Washington when we finally arrived there. And over and above all the delay, during that time we were without household goods, so in Washington we had to temporize and take rented quarters and change our daughter's school reservations, canceling it just in time, and arrange for her enrollment in William & Mary. And then Dorothy, when she finally did get the car which I had shipped to Seattle, had to drive across country during the winter with the children and finally arrive in Washington where I was to serve from then on.

Q: You were now assigned to the Construction Division at the Quartermaster General's Office. Was that at the request of General Somervell?

A: I think the fact that my orders were changed from the state of Washington to Washington, DC, for duty with him was at his specific request.

Q: You were assigned then to the Engineering Branch under Ed Leavey?

A: Yes. The construction program at that time was under the direction of the Quartermaster General. I think the administration felt that progress on this vital program was being bogged down and that was the reason that the Quartermaster General called on the Chief of Engineers for personnel. They got General Somervell, who reorganized the Construction Division and then selected from the Corps of Engineers officers whom he knew and who he felt were best qualified for those particular responsibilities.

Q: Leavey assigned you to redesign defense facilities so that they could be completed more quickly and economical y, unlike the construction that had been done prior to 1940-1941. What were your primary duties in the redesign?

A: First of all, I tried to assemble an adequate staff of engineers, and so reached out and got a number of well-qualified personnel. For instance, in my Engineering Design Section I had working for me at one time—practically the whole time I was there after we got started-I had the presidents of the American Society of Civil Engineers, the American Institute of Architects, and the American Society of Mechanical Engineers. This is indicative of the type of personnel whom I was able to procure.

It was our function to review the plans that had been previously in use. I stressed that if we were going to build, let's say, a thousand buildings of a certain type, any economy that could be made in that type structure would be magnified a great number of times.

For example, I cite one economy that seems relatively simple. We were required to provide, oh, I think 20,000 or more concrete igloos for the Ordnance Department to store bombs and other explosives on the various ordnance installations. In reviewing the design that the Ordnance Department had had previously, we found, for instance, that for lightning protection they required the welding of each joint wherever the reinforcing bars crossed. By tests and so on we found that we could reduce that to about one every 5 feet instead of the much larger number that they had.

We also found out that by revising the lightning rod installation and the reinforced concrete design, we could effect further economies and still provide the required lightning protection and structural strength. Just in these specific changes we could save from $1,000 to $2,000 an igloo, and with 20,000 of them that would represent savings of $20 million to $40 million in that instance alone. Over and above the economic savings, we effected a savings in vitally needed strategic materials. We did similar things in connection with the standard barrack design, cantonment layouts, ordnance plants, and so on.

Q: Usage of steel was a particular problem in all these defense programs of 1940-1941. How did Somervell and you go about solving this problem?

A: Well, we sought in every way to effect savings in requirements for steel. For instance, if we could use lumber, if we could use reinforced concrete in place of steel for certain structures, we would seek that. We sought in every way, I think, even to the extent of relatively minor details that went into various projects, to seek an economy of construction time and effort and particularly of critical materials, critical strategic materials.

Q: You were very involved in an extensive investigation of substitute materials wherever you could in the construction program, things like plastics and wood. Did you direct that program?

A: No, not specifically. Our function was to prepare or supervise or review the layouts of cantonments, the layouts of ordnance manufacturing plants, ordnance depots, and chemical warfare projects. And particularly, as I say, the large cantonment program that was under construction and in contemplation for the greatly expanded services that we were about to embark on.

Q: As the chief of the Design and Engineering Office, how much authority did you have to effect changes in design and construction to make these savings in material and money?

A: I think it was virtually delegated to me completely. Our plans that we drew up were reviewed, and then I would sign and approve them. I think we got another signature, maybe the chief of the Engineering Division, which was almost routine. These were the standard designs that went out to the field and those were the ones that were used by the architect-engineers and the contractors who were engaged on the construction of these structures.

Q: In 1941 a new process of site selection surveys was carried out. The surveys of potential defense sites were made much stricter than they had been in 1940. Were you in any way involved in those surveys?

A: Yes, because the architect-engineers or the group that made those surveys for the selection of such sites would submit their proposed layouts to our office, and they were reviewed then by our staff. I had a site planning section specifically y, and we reviewed the layouts from the viewpoint of economy of layout, seeing whether, for instance in the cantonment, the areas where troops were going to be trained and so on were in the best proximity to wherever the troops were quartered and considering whether or not that layout in our opinion was the best, would serve most effectively, and also could be done at a minimum of overall cost.

Q: The new 800-series plans that you came up with in 1941 were more or less of a semipermanent nature rather than temporary. But you got these through with only minor changes, and many of these buildings are still in use today. Do you recall much about your 800-series plans?

A: Not in specific detail. I do know that we worked intensively on development of these plans, and if there was any possibility to effect a change, even minor, to effect some economy, why, we would seek it out and make such change. We pointed toward the adoption of what we felt would be the best suited structure for the purpose, at relatively minimum utilization of strategic materials, and also cost, which is also a measurement of manpower and materials.

Q: In the area of defense plant construction, the Ordnance Department presented many problems because they insisted on control of design and selection of a single contractor for all phases through the actual production of the plant. Somervell and Major General Charles M. Wesson, Chief of Ordnance, waged a long and bitter conflict over these ordnance plants. Were you involved in that?

A: Not as directly as they were. But I previously referred to the matter of effecting economies in the redesign of the igloos used to store bombs and munitions. Over and above that, we proposed a changed spacing arrangement effecting further economies and still affording protection against a mass explosion of all of them. But when we made these changes in the standard plans, indicating potential savings, we had a little difficulty trying to prevail on the Ordnance Department that these changes and these economies could be effected. We had to show the tests that we had made to indicate how they could get equally good lightning protection with this reduced and less expensive design.

Q: There have been various appraisals of Somervell's effectiveness in the Construction Division. What are your views on the role he played?

A: Somervell was a very active, driving leader. For instance, if it was his job to get something done, why, the most important thing in life at that time to him would be to get that job done. And he was forceful, he was articulate, he could meet up with anybody who was opposing any of the programs in which he was involved. But he did not get into details, for instance of design, himself. He did feel that he had an organization qualified to do it, and he would give that organization maximum authority and support.

Q: So he was an excellent administrator, then?

A: Yes.

Q: But how was he on the engineering side?

A: Well, as I say, I don't think he got into the details, the engineering. I think he relied on his organization. I had [Warren H.] McBryde and [Frederick H.] Fowler and [George E.] Bergstrom—those were the presidents of the professional engineer societies that I referred to. Knowing that we had them and other highly qualified personnel of their choice and qualifications, I think he felt that he had in our organization qualified personnel to perform the engineering and the detailed design. He did not involve himself in any such detail.

Q: What about Somervell when you knew him earlier in the 1930s? How were his engineering talents when you knew him in Washington?

A: Well, my principal contact with him then was when he was a district engineer in the Washington District and I was on the rivers and harbors desk as executive assistant to the chief of the Rivers and Harbors Section. I know he was very much concerned in pushing through the various projects under his jurisdiction. I can recall his coming in on several occasions and contacting me, a junior, personally in connection with his efforts to try to get additional funding for certain of the projects in his district. If he was charged with something, he'd keep driving and driving to get the maximum in the way of approval or authority or funding or whatever was required in order to execute that particular operation.

Q: General Leslie Groves wrote that he believed Somervell could have been an excellent theater commander had he been given the opportunity. Do you think that assessment was accurate?

A: I believe so. I think he was one who, when given a job or responsibility, was keen enough to know whom to select for whatever function it was that had to be performed. I think he, too, had a driving force that would keep them on the ball, and I think he was also—what do you call it—forceful enough that he would have no compunction, for example, I'm sure, of relieving someone who he felt was not qualified to do the job and replace him with someone who was. So as a military commander I think he could have served almost equally as well as he did in the type of job heading up the Construction Division, which was a very, very vital operation for war preparation at that time.

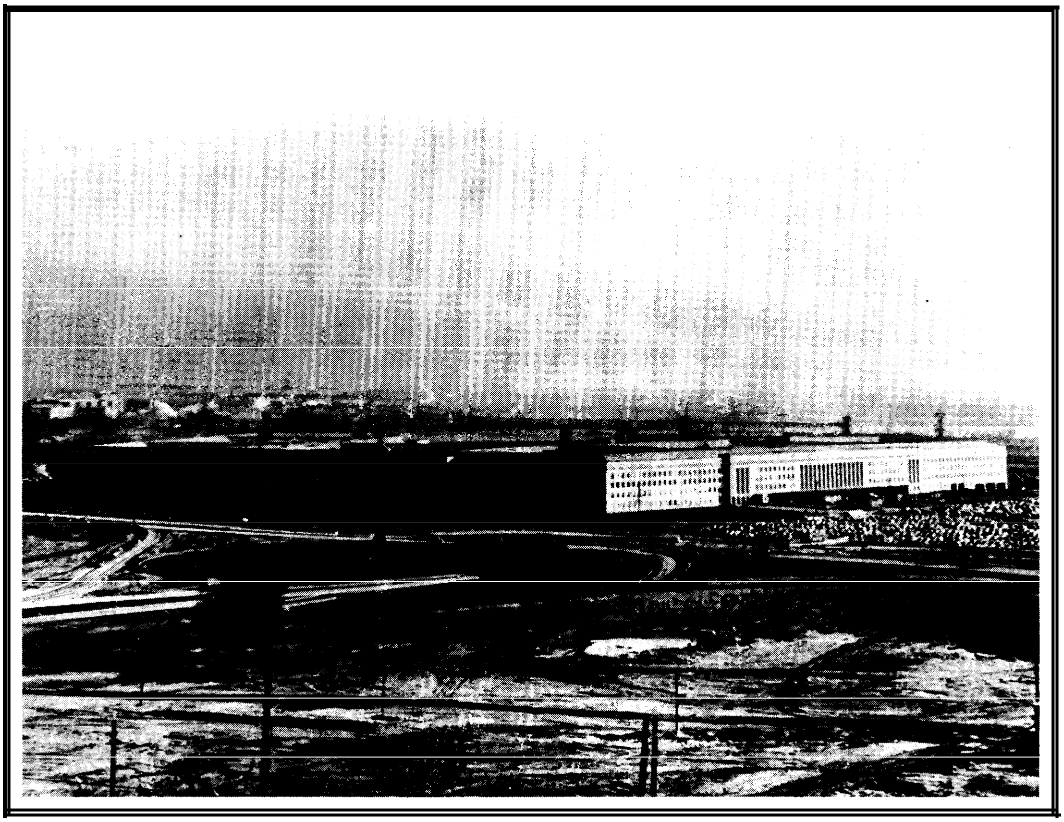
Q: On Thursday, 17 July 1941, Somervell called you in and ordered you to prepare a basic plan for what became the Pentagon. What was your first response to his order and what were your ideas and concerns about the project?

A: I can recall very well being called in. I was given no written instructions. He said, "Pat, we're going to build a, new War Department Building and we're not going to build it in Washington. It's going to be built over in Virginia on the site of the old Washington airport, the Gravelly Point Airport. It's to be for 40,000 people with parking for 10,000 cars, 4 million square feet of area-that's at the ratio of 100 square feet per person-not over four stories high and no elevators, solely ramps, and on Monday morning I want a general layout and design plan and perspective and so on for that structure. The structure is not to be air conditioned, and we want 500,000 square feet ready in six months and the whole thing ready in a year."

Well, that was a big order, so my staff and I had a very busy weekend trying to visualize the construction of a new office building, probably the largest one in the world at that time, and under the conditions and height limitations that were set. But those were my verbal instructions; there was nothing in writing. So we had to proceed from there.

I might say that on Monday morning he did have our layout plans, the architectural perspectives, and the general description of this structure conforming generally to his instructions. As I say, it was a busy weekend.

After receiving his instructions, I got Bergstrom and some of our design personnel together and we made tentative layouts. We knew we couldn't go vertically as he had said it was to be a four-story structure. And not going vertically and requiring that amount of office space meant getting a vastly spread out area. You have to visualize that here's a city of 40,000 people



Pentagon construction, 30 November 1943. Northeast exposure showing part of the south parking and access roads.

who don't go by car from house to house but just by foot within the structure to make contact between the various agencies that would be in this vast building. So we finally came up with what turned out to be a group of concentric and interconnected five-sided structures which later on was called the Pentagon Building because of its pentagonal shape.

I was a little concerned about the Gravelly Point location that he had designated. I did ask something about other equivalent areas over there, and he indicated, well, he'd give consideration to them. So we looked over the map of Washington, and I tried to figure out other suitable areas. We were afraid of the foundation conditions at the Gravelly Point site, and as it was right on the riverbed it was also possibly subject to flooding. At that time I thought that the large plateau area adjacent to the Lee Mansion area and Arlington Cemetery seemed ideally suited from the viewpoint of foundation, utilities, water supply, traffic to and from it, and its high location-all making it a very desirable site.

So we laid out tentatively this new structure on that site. That weekend we also sent a small survey party up there laying out and checking on the actual physical terrain. And Monday morning when we submitted this plan, we indicated that this was for a structure at that location adjacent to the Arlington Cemetery. On Monday he got it, and I think he took it to General [George C.] Marshall, Chief of Staff, and the next day to the Secretary of War, and then the next day to the President. Before we knew it, why, we were in action ready to build the Pentagon.

From then on it meant that we'd call in architect-engineers on specific phases, such as mechanical and electrical, and also contractors in connection with doing it on a cost-plus basis because it would be impossible to prepare detailed plans and specifications and call for bids and so on within the time limitations. There would have been a major delay in doing that. So it was done, as were a number of the other defense projects, on a cost-plus, fixed-fee basis.

Q: Do you remember who specifically came up with the pentagonal design?

A: I would say Bergstrom probably has the greatest credit for it. There were, I think, Fowler and I and some of the others who were working with him on different setups and layouts, such as square, octagonal, and rectangular and so on, and finally we came up with sort of a joint expression of views and thoughts and ideas and ended up with this five-sided pentagon structure.

Q: There was a great deal of dispute and disagreement over the design and location of the Pentagon, not within your organization, but in the Congress and public groups?

A: The instructions I had from General Somervell were secret orders, and our investigation was also done just within our organization. However, news leaks out, and when word got out that the War Department was going to build a building not in the District of Columbia but over across in Virginia, I think the real estate interests and other District interests rose up in concern that here the government was departing from its policy of building all of its federal structures in the Washington area.

So there was some opposition that way. In addition, the Fine Arts Commission had always been involved in reviewing public structures, and they and similar agencies were concerned that here the War Department was going to build a building that was not going to be subject to their review, with probable changes for architectural improvement and whatnot.

At that time we were building the quartermaster depot at the present site of the Pentagon, and that was an area that was surrounded by brickyards and comparable industries. It was sort of semi-industrial. As far as I was concerned, it was far from an ideal site for the Pentagon Building. However, this agitation as to location finally got to the President, and it was President Roosevelt who directed that we not build the building at the Arlington Cemetery site, but that we build it at the site of the quartermaster depot then under construction.

So we had to cancel the contracts on this partially built quartermaster depot and redesign our layout to adapt it to this new area. I'd say we added millions of dollars to the cost by reason of this change because the foundation conditions were much more difficult and required piling and increased costs on utilities, traffic arrangements, and so on, as compared to what it would have been up at our Arlington Cemetery site.

Some of the objections that they raised on the Arlington Cemetery site were that it might interfere with the enlargement of the cemetery, along with other similar comments such as that. But I think the principal reasons in opposition were mainly the idea of having the War Department building not in the District but over in Virginia.

When we did cancel the contract and the work on the quartermaster depot buildings, we then had to find another location for it, and I recall going down, farther down toward the Alexandria area, and I found a very suitable site there. So we had to relocate and redesign the quartermaster depot site there and proceed on work from there.

Q: That depot became Cameron Station then?

A: Yes.

US Army Forces, Far East and the Philippines

Q: Clarence Renshaw was assigned to oversee the construction under then Colonel Groves' direction. What about Renshaw; how qualified was he to do this work and how good a job did he do?

A: Renshaw was a very conscientious person and was put in charge of the projected construction of the Pentagon. I might add, just about this time was about near the end of my duty in the Design and Engineering Section. In September I received a cable from General MacArthur-he had been called back to active duty to command the US Army Forces Far East in the Philippines—asking if I was interested in assignment to his command as chief engineer of this new command. After contacting Dorothy, my wife, I saw General Somervell and said that I had decided to go.

He was quite surprised, and he said, "Now look, Pat, you're following, if you do that, you're going to be going to somebody who's reached the top and won't go any further, whereas you should stick with me, and I' m on the way to the top and I'd advise you to just carry on with me. " But I said I preferred to rejoin General MacArthur. I thought this was a better opportunity to serve in case war was coming, and we all felt that was coming, so I sent a cable accepting this appointment and prepared to get ready to move out to the Pacific.

Q: Could you briefly describe what the work in the War Department was like during 1941? It must have been fairly hectic.

A: I think it could be termed possibly "very hectic. " The War Department in peace times sort of goes along in normal fashion, and all of a sudden there's a great expansion of activity, and with that many new responsibilities. That means that they probably had to call in new personnel or expand the personnel along with an abrupt addition of duties and responsibilities. I think that there were many problems in connection with adjustment to this new situation, including coordination between and with some of the agencies in the War Department. An example was with our Construction Division as in connection with funding the locations of cantonments and industrial plants, and problems such as that [and] also with the different service chiefs, as in the Ordnance [Chief of Ordnance], in connection with ordnance facilities and so on. Our relationship with the Quartermaster General, however, was not a problem in that connection. We were at that time actually a unit of the Quartermaster General's department instead of the Chief of Engineers.

Later on the responsibility for all military construction, both peace and war, was assigned to the Corps of Engineers. Wartime construction in the overseas theaters, even at that time, was the responsibility of the Corps of Engineers. But in the States it was the responsibility of the Construction Division of the Quartermaster General. I think by reason of the situation that developed, authority and responsibility for construction throughout the country, as far as military requirements were concerned, was later transferred to the Corps of Engineers, where it was a good place to have it.

Q: What was Washington like during 1941?

A: I don't have any special thoughts in connection with that. There was a great expansion of activities, in the military particularly, but I think things were otherwise going on almost as normal. I don't think they were quite as sensitive to the approach of conflict as we in the foreign theaters felt. For instance, when I was over in the Philippines later on, I felt that the concern in Washington was much less than what we and those in other areas that were directly affected by the impending conflict had.

Q: Was there any organization or person that gave the Construction Division, or you, particular difficulty during 1941?

A: No, I wouldn't say so. Not that I recall.

Q: Were you given any special preparational instructions by the War Department or the Chief of Engineers when you left for Manila?

A: None. None at all. Not by the Chief of Engineers; not by the War Department. I just had orders to proceed there. No advice. No information. Nothing. I just had orders. And I was ordered to fly, so I flew to the coast. At that time we had only seaplanes-the Pan American Clipper-so you didn't make a direct nonstop flight to the Philippines. From the coast you'd take a flight to Hawaii and then to Midway, Wake Island, Guam to Manila. It would take five days by Clipper to get from San Francisco to Manila. Actually I was delayed two further days because of plane difficulty in Hawaii and weather difficulty in Guam.

Q: On your way across the Pacific, you stopped at a lot of American outposts like Hawaii and Guam. Did you sense any anticipation of trouble with the Japanese by the military officials or naval officials you talked to?

A: Not particularly, no. At Hawaii Colonel A.K.B. Lyman, then department engineer, who had been over me as district engineer in Boston, had me stay in his quarters during my stopover. In the ordinary sense of preparation for war, you didn't feel any sense of hysteria or concern. I think they had the attitude, which all of us felt, that if anything was going to happen in connection with Japan, they were going to hit the Philippines first because Hawaii was a far distance away. I think they probably felt that the warning would come from attack out in the Philippines rather than on their doorstep.

Q: What did you and MacArthur discuss when you reported in October 1941?

A: I think it was a very brief meeting. I had served with him for three years before. [assume that he knew what I had done. He greeted me and indicated that we were in a condition of preparation for greatly increasing the defenses of the Philippines, stressing that there was an urgent need for airdrome construction for the air forces that he contemplated receiving. And then sort of said, "Well now, Pat, just go to it. "

Q: So there was no discussion of plans?

A: No, no discussion of military plans or anything. Just a cordial greeting of welcome on my return. In accordance with policy that he had shown previously, he said, "This is your job, now you take care of it. " But there were no specific directions as to how or when or why.

Q: Was this typical of MacArthur throughout your experience with him during the war? To just give you an order and rely upon you to carry it out without detailed instruction?

A: I would say generally that was so. For example, it wasn't his custom to call in, let's say, some Army commander and give him all the details as to how he was going to conduct his campaign. He would prepare operating instructions to a command for our subsequent operations. Most of our operations subsequently involved the landing and taking over an area, building an air site there, using that as a base for the next advance, and so on. In each case such as that, orders were issued to the task force commander including specific details as to the type of field, number of hardstands, and certain other base requirements.

Q: What did you do first after you had talked to MacArthur?

A: Well, the first thing I did was to go down to organize an office. One thing I was lucky in. I had served, as you know, with the National Power Corporation. I had had a Filipino secretary, a man secretary, a very capable stenographer, and so I contacted him and engaged him as my secretary, and it was very, very helpful to have somebody to whom you could give dictation and who could handle it rapidly. Because among the enlisted personnel it was exceptional at that time to find someone who was a qualified stenographer.

I, of course, contacted the staff in connection with the general situation, particularly with G-4, General [Arnold J.] Funk, who was then also a lieutenant colonel. Later on, after the fall of Corregidor, he was captured and made a prisoner.

My principal problem or concern then was to advance the construction of the airdromes that we were improving or building in the Philippines. We were expanding the major Clark Field installation and had many other airdromes that we were developing or improving.

One of the difficulties that we had was that as it was still peacetime and the Philippines was a commonwealth, in order to get, for instance, land for an airdrome site or its expansion, we had to go through the usual peacetime procedures of contacting the land owners and making arrangements for the right-of-way or acquisition of the property, which caused obstructive administrative delays.

There also was a shortage of the large general contractors such as you have in the States and a shortage of heavy construction equipment. One possibility for such equipment was with my former Caliraya project. When we built that large hydroelectric earth dam there was no heavy construction equipment in the Philippines. As I previously indicated, instead of calling US contractors to build it at greatly increased cost, we went out and procured, for the National Power Corporation, large earth-moving equipment. We acquired tractors and dozers and large trucks, and indicated in our call for bids that this construction equipment would be made available to the successful contractor, thereby permitting the various Philippine contractors to bid. So we'd widen the area of competition, which was one reason that we got very good bids.

That meant that the National Power Corporation had all this heavy construction equipment, and so one of the first things I did was to arrange to acquire for the United States Government this construction equipment, then about to be surplus. By various and sundry means we would acquire the materials, equipment, and whatnot in order to expedite in every way possible the construction of these airdromes. We also were busy with the Philippine Army phase in constructing or expanding the cantonments or camps where the Philippine Army divisions were going to be located if, as, and when they were mobilized.

Q: What were the conditions of the defenses of Manila Bay and Subic Bay when you arrived in October 1941?

A: Corregidor had been built as a major permanent fortification, provided with heavy seacoast artillery and whatnot. But similar to the situation down at Singapore, its artillery, guns, and armament and so on were pointed to an attack from the sea. Their defenses were against a naval force coming in from Manila Bay, and not from an operation over on Bataan. It was the same situation in Singapore, where they were protected against a sea offensive but not against an attack from the land.

Later on the Japs came down on the land and took Singapore in relatively short order.

But the War Department had finally come to a decision that it was necessary or desirable to increase the defenses out in the Pacific. Prior to that time, anticipating independence for the Philippines, it had been the policy to sort of let things go. Nothing had been done in the way of improving any of the armament or other military facilities in the Philippines. They were just on sort of a maintenance basis. But shortly before I arrived, the decision had been made to actually and aggressively increase the defenses.

Many troop units were organized to be sent out to us in the Pacific. Additional armament, guns, and other equipment were on order and would be sent out. Additional air units were scheduled to come, and that of course meant the building of additional airfields and their improvement. The signal facilities were also scheduled to provide radar protection and so on, and preparations for all of this were under way at that time.

When war broke, it had not been accomplished. I think if we had had three or four months more before the war actually broke, we'd have been in a much better position for defense. But as it was, we were sort of in the initial phase of defense reinforcement when the war did break.

Corregidor, I'd say, was in very good shape, as I said, other than that it was not prepared for a land attack as compared to a sea attack. Corregidor was well protected and equipped to withstand, let's say, a naval approach into Manila Bay, which had been its primary and initial purpose. With the development of air power and the potential for bombing, an installation such as Corregidor or other similar installations became more vulnerable. But the tunnel structures throughout the island were very formidable and could and did withstand much heavy aerial bombardment.

Q: Did you ever go out to look at Fort Drum?

A: Yes. I think I just went out one time and observed it mainly as an item of interest. I didn't think it was something that was a sensational or key element of defense.

Q: It was sort of an oddity then?

A: Yes.

Q: Apparently it held out very well.

A: Yes, it was a good facility, but I don't think other than what you would normally have in providing a defensive installation on an island.

Q: Despite the fact that the current war plan, which was called Orange 3, specified a defensive war in the Philippines based on Bataan and the fortified islands, very little work was actually done on the Bataan defenses prior to the war'?

A: Well, even under the Orange Plan, I don't think anything had been contemplated particularly on the provision of major defenses in Bataan. Nor at that time were we doing anything to increase the defenses on Bataan other than airdrome construction and so on. The plan contemplated that we would delay the advance of the Japanese to defense positions on Bataan in order to secure Corregidor from the land. We were to conduct a normal defense operation with what troops we had on Bataan, and for a temporary period, because it was anticipated that it would be merely a delaying action and then the Navy and other reinforcements from the States would be sent on over and they'd be the real force to conduct the subsequent operations.

Q: MacArthur and George Grunert, who was the Philippine Department commander, made quite a bit of progress improving the defenses of the islands in 1941. How much of progress in improving the defenses in 1941 was Grunert's effort?

A: Well, prior to MacArthur's being recalled to active duty, it was all Grunert's effort, because MacArthur's function then was only as military adviser to the Philippine Commonwealth and to develop the training of the Philippine Army. When MacArthur took over, it was his responsibility and that of my office as far as airdrome construction was concerned.

Prior to that it had been under the department commander, General Grunert, and his department engineer, Colonel Stickney. Lieutenant Colonel Mielenz was his deputy. Colonel [Roscoe] Bonham of the Philippine Scouts was an assistant on supply; Major (later Colonel) Wendell] Fertig, an engineer reserve officer, was also on duty with them. Major Fertig was the operations chief who supervised most of the airdrome construction that was under way at that time under the department engineer.

Q: Did you know much about Grunert?

A: I had met him during my prior detail there. He's a very pleasant person. I had no real official dealings with him at that previous time, but he was likable. I don't know of anything particularly in other respects.

Q: Although the War Department and the Army Air Forces placed a great deal of emphasis upon the B-17 as an important part of the defense of the Philippines, little was actually accomplished until late 1941, due partly to the lack of funds to build airfields but also partly to the lack of knowledge of how to build airfields for an aircraft that large.

A: I doubt the latter. I think the fields that were done in the Clark Field area were adequate for B-17 operation. Not all the airdromes that were contemplated were designed for B-17 operation. You have to keep in mind that some fields were primarily for bombing operations; others were for fighter aircraft. If you were building fields for the lighter fighter aircraft, then you're not going to take the additional time and expense and materials to develop, let's say, a B- 17 type field, because it would probably take twice as long and you'd get the field only half done by the time it was needed. So you had to reduce the standards to ensure that you could complete as much as possible in the way of airfield development for whatever purpose it was intended, rather than to go in for peacetime construction on every one of these airdrome sites, which would be crazy.

Q: On the standards of construction for a B-17 field, what were your priority considerations? Strength of the pavement, subgrading?

A: Well, we had numerous factors. You had to be assured of your approach and takeoff in connection with the flight angle. You had to be assured of a good foundation in the selection of a site, not get one that's in an area where you get a lot of seepage and mud but try to get an area that's relatively well drained and with adequate width and length. The Air Force would like to have a field as wide as possible and as long as possible. As I say, those have to be tempered by your capacity to attain reasonable standards and the effort involved in doing it.

But I think we reached reasonable standards on the length and width of runways, approach conditions, and the type of surface. And that did not mean going in for 18-inch concrete, but it meant using the materials that were available, such as macadam. For example, if you have a good foundation, adequate drainage and surface, it would withstand your anticipated military traffic.

Q: Did the Air Force officials in the Philippines understand the difficulty of building these airfields?

A: In general, no, although I don't think we had too much difficulty with that at that time. However, you talk later of the loss of MacArthur's B- 17s on Clark Field almost immediately after the war broke. MacArthur had issued orders to General [then Major General, later Lieutenant General, Lewis H.] Brereton, the Air Force commander, to remove those planes down to Del Monte in Mindanao. If they had, they would have been safely out of bombing range of the Japanese air forces on Formosa and would not have been destroyed. MacArthur felt that from Mindanao they might refuel at Clark Field and then proceed to any other bombing mission they were to undertake.

The Air Force felt that the field down at Del Monte, Mindanao, which we were building, was not fully completed-it did not have an officers club. The Air Force liked to have an officers club in connection with its airfield facility. It did not have some of the other perquisites, you know, like good living conditions, big barracks, or special facilities for the personnel. But for wartime operating conditions or similar, the facilities we had there were operationally adequate. In fact, it was later so proved by those planes that did go down.

But I believe the night before Pearl Harbor the Air Force was having some big celebration and whatnot for personnel who were returning to the States, and that may have been a factor in holding up their move until that was over. I know they were going to move within the next day or so, but the next day was too late, because that was when they were hit.

I can recall shortly before being in General Sutherland's office. General Sutherland asked me what was the condition of the field down at Del Monte. I told him they were operable but lacked certain facilities and soon, and I recall his immediately getting on the phone, calling General or Colonel [Brigadier General Francis M. "Ray"] Brady, Brereton's chief of staff, saying to him, "Goddammit, you know General MacArthur ordered those B-17s down to Mindanao, " some days before, and he almost indicated 'why the hell weren't they down there and we want them moved. " I guess they planned to do it Monday, after their big party or something else, but in any case they were on the ground when the Japanese hit.

General Brereton indicates that he was ready to take those B-17s north the day the war broke and wanted to attack Formosa. If he did, he'd have had to do it without fighter escort, and I hate to think of what would have happened to them from the massive Japanese air forces on Formosa at that time. I don't know the details as to what happened as to such [a] request. I think he was not granted the permission to do so, and he claims that that's the reason why he lost the B- 17s. He indicated that if he had been permitted to go up and bomb Formosa, it would have been entirely different. However, if he had conformed to orders to move his planes down at the time MacArthur ordered him to, they would not have been lost. Furthermore, if they had taken normal precautions, particularly as we did not yet have radar coverage, which was contemplated and projected, and if he had kept some fighter planes up as coverage, let's say during the noon hour when all the pilots were in having lunch with all the planes lined up, the Japs might not have been able to come in and destroy everything.

If they had kept some reconnaissance or fighter planes up to provide security, and the B- 17s could have taken off prior to the attack, then the situation would have been different. This is not according to Brereton's story, but I think, insofar as I saw it, that was the situation.

Q: What was your opinion of Brereton?

A: Not overly favorable. I recall when he first came in. He went through the office facilities that we had, and I think he had a swagger stick with him to help him to sort of indicate that "I want this changed and this out, " and so and so, all in a very brusque manner. Later on we had this incident, the loss of our planes. Then when we moved over to Bataan, I can picture his office. He was there for just a short period, but I can still see a map which showed Australia. Thousands of miles down in the southwestern part of the map, in the Perth area, was his projected location for his Air Force headquarters. It sort of indicated that his plan was for moving on down, and he was going to have his headquarters location down there. Well, that was so far removed from our potential combat areas that I just could not understand what it was all about.

Anyway, later on he moved out and left the Philippines, left Brigadier General [Hal] George, General "Pursuit" George, a very fine officer, to be in charge of the Air Force efforts. Later on Brereton was assigned, I believe, to the India Theater, and I remember later seeing a picture in *Life* magazine which showed General Brereton seated at a mahogany desk with a pen and so on, with a subline underneath which said this was a picture of General Brereton, the new commander of the Air Force in the India Theater. It said that at the time this picture was taken, 'he had more air conditioning units than he had planes. " I thought that little squib, to my mind, typified some of the characteristics of Brereton, or so I sensed. Later on I heard of the Ploesti Raid that he directed, and I do recall that there was a tragic loss of life and planes on that raid. Now, whether or not the results accomplished merited the losses, I don't know, except it was one of the operations that Brereton conducted in the European Theater. But by and large, I thought that there were many other Air Force commanders better than he.

Q: Did you know Francis "Ray" Brady, who was Brereton's deputy at that time?

A: I knew him just casually; I don't recall any great detail as to the matters we took up with him, other than my previous reference to Sutherland's telephone call to him.

Q: Do you believe that your previous tour in the Philippines and your knowledge of MacArthur and your recent experience in the Construction Division allowed you to move more quickly and effectively when you did become the engineer in the Philippines?

A: Yes, I would say so. With increased experience and increased knowledge, one naturally should be better qualified. I was in a little embarrassing spot. At that time I was a lieutenant colonel, even though under Somervell's office they were in the process of having me promoted to colonel, and in fact some such word came to me as I was en route to the Philippines that my promotion had gone through, but it had not. When I debarked at Manila, I was a lieutenant colonel. Colonel Stickney, a full colonel, was Philippines Department engineer, and here he was under me, and I was a lieutenant colonel having to issue instructions and directions to him, which made it a little difficult, I think, on both sides. However, he cooperated very well, and we had an excellent mutual understanding and relationship.

One other thing which I think helped greatly was from my previous experience in the Philippines. The National Power Corporation had on its board of directors the director of public works, Mr. Fragante; the president of the Manila railroad, Mr. Paez; and other prominent government officials. So I got to know them as a result of my dealings with the National Power Corporation. I also got to know a number of officials in the Public Works Division, their district engineers, and so on. And later on, after the outbreak of war, I had to make many direct contacts, for instance in taking over the Manila railroad, which we did, and the fact that I had a good personal relationship with Mr. Paez was very helpful in that. The fact that I knew the director of public works and their district engineers was very helpful in connection both with the construction and also particularly in connection with our demolition program after activities broke out. My prior contacts with Philippine Army headquarters, and in particular with their Corps of Engineers, were especially helpful.

Q: Despite the importance of defense projects in the Philippines, supplies, equipment, spare parts, construction materials, all moved very slowly to the islands. Was this due to distance alone or was it due to a combination with competition from lend-lease and other high-priority defense projects?

A: I would say it was a combination of many things. I think the administrative procedures, the procurement, the problems on priority of transportation, and I think the priorities of other military construction needs within the United States-on their construction program, for example—and other matters such as that affected it. That was one of the reasons that we resorted to the maximum to local procurement of whatever we could get; for instance, lumber from the lumber mills and such things as were manufactured in the Philippines, and procurement of all other items and equipment that we could get there.

Q: Although MacArthur finally did request and receive from George Marshall a higher priority for the Philippines, it came too late. Do you think that more could have been done in Washington to aid you?

A: Well, first of all, if people in Washington knew war was coming on a certain date, naturally much more would have been done more expeditiously. I think that with peacetime procedures and activities, they operated in more or less a routine way in doing things. For instance, I had had a number of requisitions pending in Washington for equipment and materials, and so on, particularly for our airdrome construction program. I recall maybe three or so days before the war broke, I was so concerned about their delays that in the clear, rather than in code, I got on the overseas telephone and even called the Chief of Engineers' office in Washington, and I listed a lot of the critical items, indicated the urgency, urging them to try to push things forward as fast as they could. That was indicative of one of my concerns about trying to expedite delivery of critical things that had been on requisition for some period of time.

Q: You say you called the Chief's office. How frequently did you get into direct communication with the headquarters in Washington?

A: That was the only time that I did by overseas telephone. MacArthur's headquarters and some of our staff probably were in such communication with other War Department offices. That was the only occasion, outside of wires and correspondence. What I was indicating was sent in the clear, and if the Japanese were listening in, overhearing the urgency of our needs here, they could easily get that. But I felt the need was so urgent that I was on the phone quite some time, listing all of these problems.

Q: The arrival of the 803d Engineer Aviation Battalion and then the 809th Engineer Aviation Battalion eased the situation somewhat, did it not?

A: Greatly. They were the first, you might say, organized and equipped and trained units qualified for that specific task. If we had two or three or four more of them, it would have been very helpful, or other similar construction units of the Corps of Engineers, of the Army engineers. At that time the Air Force was under the Army, so the aviation engineer units were really, you might say, also Army construction units.

Q: The only Army engineer unit you had until the arrival of these two units was the 14th Engineers (Philippine Scouts)?

A: Part of the Philippine Division.

Q: How good a unit was that?

A: It was excellent. The whole Philippine Division was excellent. These were Philippine troops, except for one white regiment, who had enlisted, and they were very, very loyal. It was considered an honor to belong to the Philippine Scouts. They routinely reenlisted, and there was a strong sense of loyalty and patriotism. They were an excellent unit, including the engineer regiment. It was unfortunate that just prior to the war the War Department changed the organization of the square division to a triangular division, and instead of the four infantry regiments of two brigades, they changed to three regiments, and in doing it, they reduced the engineer unit to a battalion. I strongly feel that every division needs at least a regiment, or several battalions, of engineers in all operations. We had just the single battalion that went with the division. Throughout our subsequent operations, it was always necessary to supplement the divisions with additional construction battalions or comparable-type battalions that could give them additional engineer support capacity.

When they did break up the regiment, the Philippine Scout engineer regiment, we did have one advantage from it, as I previously stated, and that was that certain key personnel became surplus, whom I assigned to the engineer units of the Philippine Army. They served as key personnel within these various units and greatly strengthened those otherwise relatively untrained and unequipped Philippine Army engineer units.

Q: What do you think of Lieutenant Colonel [later Colonel] Harry A. Skerry, who was the commander of the 14th Engineers?

A: Colonel Skerry. Skerry was a dedicated, loyal officer and performed very well commanding that regiment. Later on, of course, he became engineer for General Wainwright's force, and as such also performed very well. I think he could have been a little more imaginative in anticipating certain problems and so on, but when given an assignment and certain things to do, he performed very diligently and effectively.

Q: As part of his overall plan to defend the Philippines, General MacArthur ordered a buildup of the Philippine Army to some 12 divisions. In turn, he ordered you to develop an engineer force for his new army. Was your advice sought on the mobilization plan?

A: Not particularly, except in certain details, such as the problems of cantonment construction and facilities for the arrival and training of these units. I don't recall any instructions specifically to develop an engineer force from the Philippine Army, other than the division organizations.

Q: How long do you think it would have taken to train the engineer combat battalions and other engineer units that would have been necessary to support such a force?

A: From the Philippine Army? Oh, I'd say at least three to six months more, because they were relatively untrained when they were called back into active duty. There would also be a major need for engineer equipment and transportation.

Q: We were discussing the plans that General MacArthur had to expand the Philippine Army. Do you believe that in the situation you faced in late 1941 that his mobilization plan was a little unrealistic?

A: I would say so. I'd say the basic plan was. First of all, it contemplated that the Philippine Commonwealth would appropriate the necessary funds to carry this program through, mainly to develop, to organize and train ten divisions each year for six months, and then this personnel would go on reserve. Then they would train a new, similar increment over a ten-year period, so that ultimately you would have a million men, less attrition losses, that would have received some training.

But the facilities were limited, personnel were equipped just with hand arms, there was a lack of equipment and a lack of transportation, and a lack of funds to get equipment. The plan was to develop also a small naval force, limited just to PT [patrol torpedo] boats, and I think they got only four or so by the time that war broke out. The engineers had very little in the way of equipment other than hand tools. We were also to develop a small Philippine air force.

Q: You were apparently aiming for a force of Philippine engineers equivalent to approximately 20 percent of the Philippine Army, but you had barely 5 percent by December 1941. What was your view then, and what is it now, of the proper proportion of engineer troops to all Army forces in an operational theater?

A: As indicated in our subsequent theater task force operations, the engineer complement ran from 20 to 50 percent. Each operation was primarily an operation to land, take an area, and develop it as a base including major air facilities. In other words, the engineer mission was the primary objective or purpose in each specific operation. I think that it would be desirable to have a larger engineer percentage in our military establishment than we have currently. I think that it would be very desirable to have an engineer regiment instead of a battalion in the division. I think also that much could be done in the organization of other engineer units.

For instance, equipment is vital, and the operation of equipment is even more vital, and yet the organizational setup provides for but one operator for each piece of equipment, instead of two or three. In time of need that equipment is going to be utilized on a double- or three-shift operation, and you are going to need more than just one qualified operator. There is also a need for engineer maintenance units, because in time of war equipment is operated by relatively untrained personnel, and it is operated under great stress, often round the clock, so that maintenance needs increase. There is a need for special units like engineer parts companies and engineer equipment companies to have a reserve of equipment available to serve additional requirements on special situation.

Q: When MacArthur became commander of US Army Forces of the Far East in July 1941, he left the staff of the Philippine Department as a separate headquarters. We have talked about the problem you had supervising Colonel Stickney. What other problems were inherent in such a dual staff structure?

A: I really didn't have any problem with Colonel Stickney, other than it was sort of a little embarrassing situation. I think that our relations worked out quite well. I don't know of any major difficulties that we had. I think it functioned relatively smoothly. I think it would have been better if we had the staff headquarters of the Engineer Department as part of our command structure. But the way we worked, with direct communication rather than through command channels, it still worked out very well.

Q: On 26 November 1941, the War Department notified MacArthur that US-Japanese relations were deteriorating and that troops should be alerted to meet any surprise attack. What actions did you take in response to this information?

A: I think those instructions were issued to the commands, in secret to the senior commanders. I don't recall when they mobilized the Philippine Army divisions, but I know that possibly a month before we had called into active duty the engineer units of the Philippine Army divisions because there was a prior need for them in connection with developing the cantonments and camps where the troops were going to be received and set up for training.

Q: As an important member of MacArthur's staff, how much did you really know about the worsening relationships with Japan?

A: Not as much, I think, as I could have received, because much of it was top secret, such as the extent of the worsening relations with Japan and instructions from the War Department-they didn't make copies of that and distribute them literally to the staff. We just sort of knew that a critical situation was developing.

Q: Do you think that there may have been a little too much security consciousness in MacArthur's headquarters?

A: Possibly.

Q: How much do you think MacArthur knew about the Japanese intentions or his estimate of the situation?

A: Well, he sensed that war was pending, and the fact that we were stressing defensive preparations was indicative of that, and the instructions from the War Department supplemented or confirmed, probably, what his views, original views, were.

Q: How well did MacArthur get along with Admiral Thomas C. Hart and the naval officials in the Philippines?

A: I think relations probably could have been closer. I think MacArthur felt, as when he was later Supreme Commander where he had the Navy also under his command, that he would have preferred that rather than to have Admiral Hart and his naval force operating as a separate command. It meant that there were sort of requests made from one to the other, rather than instructions. So in other words, MacArthur did not have control of the small naval force that we had out there. It was all directly under Admiral Hart. I also think they could have and would have been used more effectively under General MacArthur.

Q: Do you recall how and when you were notified of the Japanese attack on Pearl Harbor?

A: I recall very well. I was asleep in my quarters at Military Plaza, and early in the morning on Sunday, December 8th our time, I was awakened by Spencer Akin [then Brigadier General, later Major General, Spencer B.], the Signal Officer, who shook me and wakened me and said, "Pat, get up. The Japs have attacked Pearl Harbor."

Now, Spencer Akin was one who had a soft voice, but under stress, when he was really under stress, as he talked, his words would come out in sort of a hoarse dramatic whisper, as though it were a whisper. Anyway, he was shaking me and telling me this, and I got up sort of surprised, and I said, "Well Spencer, why are you whispering? Don't the Japs already know it?" Whereupon he sort of shook his head. But anyway, that was how I was advised. So I got up General Sutherland, our chief of staff, who also lived in our quarters. We all got up. I know he took time to shave, Sutherland did, and we all then proceeded down to MacArthur's headquarters at 1 Cane Victoria. Naturally we were extremely busy from then on.

Q: What was MacArthur's first staff meeting like?

A: I don't actually recall that he called a staff meeting. I think we were all going about it in our own individual areas of responsibilities.

Q: Do you recall what his initial reaction was, or his attitude?

A: No. I think it was sort of an analysis of the situation. I don't know what specific direct action he took, either in communication with Washington or other headquarters. I know he furthered the advice and information to the major commands, to the Air Force headquarters, to naval headquarters. The Navy had gotten separate instructions through their channels. But I think those communications were going on between the senior commanders and our headquarters.

As I said, I don't think it was one of hysteria or anything like that. It was one of surprise to all of us that the Japanese had chosen to attack Pearl Harbor rather than the Philippines because we thought we were going to be number one—as I think they also thought in Hawaii.

Q: Do you think that had the Far East Air Force survived the early air attacks at Clark, Nichols, and Iba fields, it would have changed the situation for the Philippines in the long run?

A: It would have, though possibly not in the long run. I think if there had not been a Pearl Harbor with its destruction of the Navy, it would have changed it in the long run. But survival of our aircraft would have materially assisted our situation in the Philippines.

For instance, if we'd had those B- 17s, they could have been used to oppose the Japanese landings two days later at Vigan on the northwest coast and also at Aparri on the eastern north tip of Luzon. As a result, when the Japanese did attack, we had no airplanes to use against them. Unfortunately, Admiral Thomas Hart, I guess having lost our principal Navy force there in Pearl Harbor, was not taking his limited naval force and opposing those landing forces. So the Japanese had unopposed landings when they did land at Vigan and Aparri.

Q: MacArthur's strategy, which was adopted when the war began, was to go as far forward as possible and then withdraw rather slowly in front of the Japanese and keep them as far back as possible from the defense position, which was going to be Bataan. How did this alter the engineer plans for fighting the war?

A: His original concept and hope was that if the Philippine Army developed a large enough force, they could oppose the Japanese at the beaches. Well, that was absolutely impracticable and impossible at this time because any real capable landing force could make a successful landing against the limited forces which we had. I think that was recognized after they did make the landings—that our principal objective was to delay the advance of any of these Japanese elements and withdraw ultimately to a defensive position on Bataan, such as had been contemplated under the original so-called Orange Plan.

Q: Was MacArthur at all surprised at the speed with which the Japanese made their initial landings on Luzon?

A: I don't think overly so. I do recall, though, that very early on the day of the landing I got word that the Japanese had landed up at Vigan. I proceeded immediately down to headquarters. I got my Filipino secretary and I dictated an estimate of the situation and a decision and then formulated a number of telegrams to complement them. I believe this was the first, and as far as I know the only, formal "estimate of the situation" and recommended "decision" in our Philippine operations.

This was in advance of any action by G-3, G-4, the operational division of chief of staff [then called War Plans Division and later redesignated

Operations Division (OPD)], or anybody else. I recommended, one, that we not send any of our forces up to oppose that landing force as they could be cut off by subsequent landings southward, trapping them between the coast and the mountains; [two], that we take a defensive position up on the Lingayen Gulf coastal area and the mountain passes eastward, and [three], that we issue instructions to the Bureau of Public Works to their district engineers and also to the Philippine military district commanders to destroy the bridges and ferries between these landing areas and our suggested northern defense line.

I had wires prepared to send to the district commanders of the military districts and to the Bureau of Public Works. I had previously issued instructions to commandeer the explosives from the mining companies, particularly up in the Baguio area and other areas of the Philippines.

I had just about finished that when General Sutherland came in. I showed it to him. While I was showing it to him and discussing it, General MacArthur arrived, asked what we were doing. Sutherland said, "Pat has this. " MacArthur read through it and without change put his approval on it with his standard "Okay, Mac. " And we issued those instructions. I still have that document.

You might say that the chief engineer made the first "estimate of the situation" as to action to be taken after the first Japanese landing. That decision was accepted and the wires were sent out, all of which really should have been the function of G-3 with G-4 and others, including the chief of Staff.

Q: The nature of MacArthur's strategy placed a great deal of reliance upon the engineers and the plan that you developed that day, especially for the destruction of major bridges, railroad bridges, road bridges. How did you go about collecting up the civilians that you eventually got and were named "Casey's Dynamiters"?

A: I first contacted the mining companies. I knew the mining engineers were a good type of personnel, let's say, for demolition missions particularly. Many of them came voluntarily into my office. I would question them. One might say he was a superintendent or a foreman or such-and-such. I said, "Right, you're a captain, you're a lieutenant, you're a sergeant. " I commissioned them directly and personally, subject to later approval and confirmation-of course not standard military procedure.

I had indicated previously to the Philippine Department to commandeer all available explosives including the explosives the Bureau of Public Works had. We also had told the military district commanders and others throughout the Philippines to get these explosives and demolition supplies from the different mining companies.

I organized then these demolition units either to go with other military units or to be sent off on specific missions. For instance, I sent one up to destroy a most important pier installation at Masinloc up in the northwest. I sent the others with the forward forces, North Luzon and South Luzon forces, that were covering the withdrawal. The engineer units that were with the Philippine Army divisions were also given the mission of destroying the bridges as we withdrew from the successive positions. They were furnished explosives and technical assistance from the so-called" Casey's Dynamiters. "

Q: Apparently one of your most important helpers was a Mr. W. L. McCandlish?

A: He was a very, very, fine and able individual. He was a representative of the Hercules Powder Company. I think he voluntarily came in to lend his services. I set him up as sort of my principal explosive engineer and had a number of these demolition parties operating with and under him. I sent him off on specific missions, some to supplement the North Luzon Force, which was withdrawing from the Lingayen area, and with other demolition groups that were sent down to supplement the South Luzon Force that was withdrawing north from their positions.

Q: What was your relationship with Colonel Harry Skerry, who was Wainwright's engineer, and Lieutenant Colonel 'William C. Chenoweth, who was General Parker's engineer?

A: I fortunately was in the position where I could issue instructions and directives to them directly, rather than having to go through our headquarters, General [Jonathan] Wainwright's headquarters, and then from him to his engineer command. So we were in constant telephonic communication in connection with their problems and their needs, giving instructions connected with supplies, and giving specific instructions in connection with certain demolitions. That embraced, for example, the South Luzon Force in connection with extensive destruction of railroad bridges and other bridges on the line of withdrawal of their force north and the North Luzon Force with respect to specific major bridge structures in their area of withdrawal.

Q: How much more effective would the defense have been, especially those defensive actions conducted by the North Luzon Force in the Central Plains, had adequate supplies of antitank and antipersonnel mines been available?

A: They would have been very, very helpful. In that connection, it was the responsibility of the Ordnance Department to provide antitank mines. They had virtually none. Knowing that they were important, I personally designed a so-called antitank mine. We were able, through a small factory in Manila, to build a vast number of small wooden boxes. We were also able to procure small electric storage batteries and contacts. So I designed what we called a 'Casey Coffin, " a small box in which we had sticks of dynamite and electric caps. We put the contacts on the under side of the cover of this box with the dynamite, electrolyte batteries, and caps inside. We had the contacts so designed that a man could step on the cover without activating the caps. If two men stepped on it, or a tank, the cover would give way and it would detonate. So we made thousands of them and furnished them to the different commands. We set up these antitank mines on the principal approach routes and later in front of our defense lines on Bataan.

In connection with what we were saying about the antitank mines, the Ordnance was also supposed to provide grenades. There was a terrible shortage of grenades. So I figured we had to do something about that. So I designed what we called a "Casey Cookie. " All it consisted of was a stick of bamboo, and inside of it we had dynamite, possibly nails, broken glass, and whatnot, and a detonating cap, sometimes percussion and some with time fuse, and a handle whereby you could swing it, similar to a hand grenade. They worked rather effectively, particularly during the defensive stages on Bataan.

Q: When the Japanese landed at Lingayen Gulf on 22 December, any hope that MacArthur had of holding disappeared and he ordered the withdrawal to Bataan, as envisioned by war plan Orange 3. The engineers in the North Luzon Force then became critical to allowing the South Luzon Force time to pull back across the Pampanga River.

A: Yes. Incident to that, I had Captain or Major (later Colonel) Manzano of the Philippine Scouts, who knew the Philippines very well. I sent him forward in connection with the preparation of successive defense positions on the withdrawal of the North Luzon Force. I had him recruit large numbers of Filipino civilians and lay out the successive defensive positions. That didn't mean digging extensive trenches and whatnot. We did endeavor, however, to prepare certain places for potential machine gun locations, other areas where they could get a good field of fire in front of these successive defensive lines.

As to our Philippine engineer units, we didn't have the Philippine Scout division up there, just the Philippine Army. So the Philippine engineer units were the ones that were primarily charged with demolition of bridges as their divisions withdrew from each successive defensive position, blowing up bridges and doing everything they could to delay the enemy. We also had issued instructions to the military district commanders and the Bureau of Public Works prior to that not only to evacuate all critical materials-explosives and whatnot—but also to destroy fuel and any other facilities that were of use to the enemy.

Q: What were the days of December 1941 like? What were your general impressions of that time?

A: Well, I knew the engineer mission was most important. I think we were the most effective force in connection with the delay of the advance of the enemy. I was continuously busy on the phone, with wires and conferences, getting instructions out to demolition units, groups, and preparing the major demolition units. In the meantime, we were recruiting additional personnel where we could. We were commissioning and trying to arm these newly commissioned civilians. It was impossible to go through normal administrative procedures in connection with getting their commissions. We threw the book aside and did what we felt was vital.

Q: What was MacArthur's general attitude during December? Was he hopeful that reinforcements would arrive, or did he pretty well know that the situation was going to be pretty much fought out with what he had?

A: Well, he was hopeful. We all were. However, I think realistically, we sort of felt that with the loss of the Navy at Pearl Harbor it was going to be difficult if not impossible to bring in any major reinforcements. We only felt we could merely hold, hold, hold–and that the longer time we could hold, the more chance there was of possible reinforcements.

Q: Colonel Wendell Fertig put a great deal of effort into building airfields on Bataan in anticipation of reinforcements from the United States. Was that a realistic assessment or was it sort of a morale builder type of operation?

A: I think it was a combination of both. We did feel, for instance, that even though reinforcement ground units—combat units—might have difficulty getting into the Philippines, we did feel that it was possible for air units to come up by way of Mindanao and then from there on up to Bataan. We felt that our Air Force complement could certainly be reinforced, even if they couldn't get the ground units in. And in anticipation of that, we had a very active program of building these additional airdromes. I might say we had to do it with large numbers of manpower and hand tools, because not only was equipment in short supply but fuel also was limited, and we often measured any construction job by how many gallons or barrels of fuel were going to be required from our limited stocks.

Q: What was the attitude or response of the Philippine government to the situation?

A: By and large, they were very cooperative. As I say, I had a good relationship with Mr. Paez and his Manila Railroad Company. We commandeered the railroad and its facilities. I sent an engineer officer over to his headquarters as my representative, who had practically full authority under my directives as to what we were going to do to destroy railroad bridges, destroy rail equipment, that we could not get back into our own area. As I say, we had full cooperation. Also, I had full cooperation from the Bureau of Public Works, having known the personnel previously.

Q: The demolition of the Calumpit Bridge was essential to the entire campaign. How closely did you monitor that demolition?

A: I kept in touch with it right to the end. I was in headquarters at Manila. In fact, I was the last one to leave. On the night of December 31st to January 1st, I was on the phone almost continuously with demolition parties as they contacted me. I was also in close touch with Colonel Skerry and telling him that we just had to hold that Calumpit Bridge first of all as long as possible and at least until 6 A.M. the next day in time to permit the passage of some of our demolition units that I still had down south of there.

The South Luzon Force had already cleared through Manila to join with the North Luzon Force. There was nothing in Manila in the way of combat forces between the advancing Japanese and our headquarters there. The rest of the staff had already left that afternoon for Corregidor, leaving me alone. Among other demolition parties, Lieutenant [Thomas] Delamore with his platoon of the 803d Engineer Aviation Company [Battalion] and his vitally important equipment came in to me that night, and I ordered him to rush on north with their equipment prior to the destruction of the bridges on his escape route.

I had also previously sent Colonel Manzano and his demolition units to destroy the bridges between Calumpit and Manila. I kept in close touch with him on that mission. I said we wanted to be sure we cleared all elements of the South Luzon and later Delamore's force before he blew those bridges.

Then finally, when Wainwright felt that after the junction thereof the South Luzon Force and when the advance of the north Japanese force was so close, they finally decided they had to blow this strategically important Calumpit Bridge. That was about 4 A.M. that Sunday. That was a very vital bridge over the wide Pampanga River. We had it very carefully prepared by our demolition group. It was successfully blown up and in fact had not been repaired even several years later, after we got back to the Philippines.

Q: What was your estimate of the time you could hold off the Japanese in the defensive positions that you had been able to prepare?

A: All we could do was hope we could hold them off as long as possible. I don't think there was any real estimated definite time schedule. It was just a matter of dealing with and holding them off as long as possible, generally with poorly trained, under-equipped troops against a well-equipped and experienced enemy force.

In the interim, we prepared a forward defense position on Bataan, and I think that under the pressure of time and limited resources, we had it very well done. We gathered up all the barbed wire that was possible. We had taken every bit of barbed wire that was in Manila and moved it over to Bataan. We also salvaged barb wire from fences on Bataan and so on.

We had also, really by a super-human effort, gotten one of the very heavy 8-inch guns recently sent over from the States for installation on Corregidor. We moved that over poor and heavily congested roads and under extremely difficult conditions and emplaced it behind the forward defense position, so that it could cover the Olongapo sea approaches as well as the main highway crossing Bataan in front of this defensive position.

That would control the lateral movement of the Japanese after they advanced to Bataan. I just hated to abandon it later when we got the order to withdraw from our forward defense position to the so-called reserve position. I opposed that most strongly; in fact, to such an extent that when we received orders that we'd have three days, I think, in which to withdraw from the forward position to the defense position, I even prepared an "estimate of the situation" indicating the factors why we should try to hold this forward position. In sending it to General MacArthur and the chief of staff, I said, 'any decision having been made should not be questioned; but I question the estimate of the situation upon which this decision was based. " I actually don't think there was then a really adequate estimate of the situation.

General Sutherland had shortly before made one of his very infrequent trips over to Bataan and had conferred with the force commanders. I think based possibly on trouble that General Wainwright had had with the Philippine Division on the left flank-they had been broken through—I think he decided that we should withdraw to the reserve position embracing a smaller overall area.

But in that time we could not displace, for instance, this heavy gun and its fixed emplacement. We'd lose all of the barbed wire, the defensive installations, the excellent field of vision that we had over the front, the wonderfully fine artillery cover of the approach roads. In any case, no attention was paid to my recommended revised "estimate of the situation, " and we withdrew to the reserve position. There was a terrible deficiency of knowledge among the Philippine units, and even among other units, where I think they failed to understand the principles of defensive installations, such as cross-fire protection for the fronts of adjacent units, the location of units, the siting of machine guns, and other related matters.

One thing that I strongly criticized, both on our forward position and on the reserve position, was the tendency for the commanders to place all of their troops in line, in position, on these forward defensive lines. I put in several memoranda and recommendations that they reduce their strength on forward lines and provide for stronger reserves, pointing out that any enemy force by concentration can penetrate almost any portion of a defensive line and outflank and cut off the adjacent lines, so it was essential to have reserve forces to meet them wherever there was a breakthrough (Appendix F.)

The Philippine Division was largely used as such a central reserve force. I did recommend that both the North Luzon Force, which had the left flank, and the South Luzon Force, which had the right flank, supplement their defensive displacements with reserves that they lacked.

Q: So you think that Sutherland's decision to withdraw was certainly hasty?

A: That was my personal reaction.

Q: That decision to withdraw was made by MacArthur, though?

A: Yes.

Q: But you think in this case it was based on inadequate information?

A: Yes. You see, I was on Bataan all the time. I'd make trips over to Corregidor at night. We would review the situation there. I also was covering the front at all times-I and my staff assistants. I had Major William Gay. He would daily cover one portion of the line. I had Lieutenant [Thomas] Delamore to cover another section. I had Major

Manzano and Major [Alfred] Kircher, all very able and dedicated officers, also on my staff on Bataan.

From my office I made or had almost daily field inspections of both the fronts and the flanks. I was continuously putting in recommendations and suggested changes in the defense setup. I might say that later on—this was after I heard that I with General MacArthur and selected members of his staff were going to be ordered to Australia—I decided to cover, together with Major Gay, on foot, the entire front starting on the east coast over to the west. (See Appendix G.)

During that three-day trip I went into all the forward outpost positions, the machine gun positions, the front and support lines, and directed many changes here and there. Upon my return I put in a long report pointing out a number of deficiencies that existed. It was obvious that many unit commanders had not inspected their respective positions or, if so, lacked the knowledge for their improvement. Later on I know that General Wainwright, when he took over command, disseminated these comments and directed appropriate changes to the forces there. In fact, that report is published in full as an annex in one of our volumes on engineer operations in the Southwest Pacific.

Q: Do you think that possibly MacArthur's staff was not as connected to the situation on the front as it should have been had it been on Bataan?

A: I felt that MacArthur's staff on Corregidor should have had more contact with the situation on Bataan. I have always stressed *personal* reconnaissance and the importance of commanders personally checking on the situation within their respective jurisdictions. I might add that General MacArthur had not been out to see any of the units during the withdrawal phase on Luzon. He also had not come over to Bataan.

I remember finally writing a handwritten message to him stressing and urging that he make a personal appearance over in Bataan to see the troops and to be seen by the troops. I indicated that if and when hostilities were over and it was found that he had never been there—I didn't use these exact words, but that was the intent—that it would be unfortunate. I said, "However, recognizing that you may feel that you should be at central headquarters continuously and it therefore is not possible to come, I recommend that you issue a statement to the command such as the following. " Then I forcibly outlined that we must hold—pointing out the need of holding on. I said, "Reinforcements are on the way. " We didn't know that they actually were, but it was necessary to get that thought across to our units. I indicated that the whole world was looking to us, and so on, stressing the urgent need to hold on.

The very next day General MacArthur came over for his first and only inspection of the Bataan front. Not only did he come over, but he also issued a statement somewhat in line with what I had indicated. In fact, later on he was criticized for issuing the statement to the troops that "reinforcements were on the way, " as I had used in my draft. It was more with the objective of stimulating morale.

Q: After the Japanese air forces had destroyed the American air forces, or largely destroyed them, do you think they really used their aerial dominance as well as they could have to prevent the movement of the American forces in the Philippines?

A: I think relatively so. After our withdrawal from Manila they possibly could have inflicted greater damage on our forces by concentrating, you might say, on the destruction of our personnel rather than other facilities. But I know that we were surprised at their accuracy and their ability. They'd come over in formation, let's say at 20,000 feet elevation. We'd see our anti-aircraft shooting at them. But maybe we could only get to 17,000 feet, or several thousand feet below them. So they came over in perfect formation and would hit their target rather precisely and do it, I thought, extremely well on the airfields. They specialized in destruction of the airfields as well as Corregidor, our Navy base, and other installations.

In Manila we had the Pandacan oil installation, a major concentration of the four principal oil companies. We had a massive concentration of oil storage tanks there. They came in and bombed Manila but did not drop one bomb on or near that installation. They had hoped that when they took Manila they could take possession of all this critically needed oil, still in storage, and therefore they did not want to destroy it.

Well, I fooled them on that. During the week from Christmas to New Year's we concentrated on the movement of all available oil supplies from

Manila to Bataan. This was also during a critical period, because MacArthur's headquarters had pulled out on Christmas Eve, and he had declared Manila an open city. I had been up on one of the North Luzon defensive lines, and when I came back that evening I found that General MacArthur and his headquarters had suddenly moved over to Corregidor.

For the next week Manila was an open city. We had no defenses, no anti-aircraft or anything else combatwise in Manila during that critical period. It was vitally important to move all possible equipment, supplies, and petroleum to Bataan. We commandeered barges, water transportation, and trucks in addition to the railroad for such movement.

The Transportation Department was giving priority to "bows and arrows and groceries" —in other words, ammunition and food and so on. So the engineers had to scrape up our own transportation. And our supply man, [Roscoe] Bonham, did an outstanding job in getting our engineer supplies and equipment over there. We also tried to get as much fuel and lubricants also on barges, trucks, and rail. But anticipating our final withdrawal, I had prepared the Pandacan oil installation for destruction. I commissioned a Mr. Ramey, who was with Socony-Vacuum, made him a lieutenant and gave him a large demolition detail. We then prepared demolition charges on all the tanks and installations there at Pandacan.

At 6:00 P.M. New Year's Eve, after all of our forces had pulled out as well, after our and other headquarters had all pulled out, I had Ramey and our demolition group blow up that installation and destroy all the tanks and their remaining storage. We also fired automatic weapons into the lubricants that we had not been able to evacuate. We destroyed it all and prevented it from getting into Japanese hands. The Japanese had been very particular in their bombing that they would avoid that while hitting other targets in the area. They had, prior to the outbreak of war, been embargoed from their oil supplies, so that oil was to them most vital.

Q: Going back to the Japanese again, what were your estimates of the Japanese military capabilities from the fighting that had taken place up to the time you withdrew to Bataan?

A: It probably wasn't a fair indication of what it was. You have to keep in mind that our Philippine troops were comparative y untrained. They were ill-equipped, with no artillery, transportation, short of automatic weapons and whatnot. It was almost a situation where when the Japanese appeared and approached and these troops were under heavy fire, the first thing they thought of, instead of holding on, was to withdraw to another rear position. The principal deterrent to the Japanese advance would be our engineer units blowing up the bridges and their approaches. But as indicated later in our operations in New Guinea, the Japanese proved themselves as an excellent fighting force. They thought that capture was the worst disgrace that could occur; death was preferable. Sometimes, even though their situation was impossible, they would still hold on, creaiting heavy casualties compared to the losses incurred by their final group that was left. They resisted to the bitter end. They were an excellent fighting force. There was no comparison between them and the untrained Filipino. One strong force that we had was the division made up of the Philippine Scouts. They performed well.

Q: Did the Japanese deftness in jungle fighting surprise you?

A: We knew that they were excellent at it. We sort of felt that with their experience in China and having been a fighting machine, having been well trained and equipped, we expected that they would be.

They were also ready to exist on short rations. They weren't accustomed, the way the American soldier is, to special food and all the perquisites we give our troops. Our troops basically, in peacetime, are, or at least were, not prepared for circumstances under which they fight and live under jungle conditions.

Q: How much longer do you think the forces could have held out on Bataan had they not withdrawn from that front line to the reserve position, as you mentioned before?

A: Well, no one knows. I just felt the forward position was much better. You always have the ultimate opportunity to withdraw to a reserve position. But I think our forces would have been more effective and our defense potential greater in that forward position than it was in the so-called reserve position. We had excellent observation for artillery coverage, control over the lateral Olongapo Road, relatively improved defense positions with barbed wire protection, as well as a fine lateral road to the rear for movement between the separate North and South Luzon forces.

Q: How much did MacArthur's initial decision to hold away from Bataan cause a dispersion of engineer supplies and a lack of proper preparation of defenses in Bataan?

A: How do you mean, hold farther away?

Q: Rather than retreat immediately to the Bataan peninsula like the war plan originally envisioned, but to send his forces out, like the North Luzon/South Luzon forces.

A: Well, I think that was a reasonable and proper thing to do based on the time schedule that we had. I don 't think the Orange Plan or any other plan contemplated that as soon as war broke we'd immediately move over to Bataan with all of our forces without giving resistance, because to let an enemy force come down without resistance, they'd have no casualties, they'd have full equipment and ammunition and defense would probably be more difficult.

Q: What do you think prompted MacArthur to sort of sequester himself in Corregidor?

A: Well, that was his principal headquarters. He had excellent radio communication facilities. The staff was well protected; they were in the tunnels. I think it was the logical headquarters for the command. However, I think that representatives of the staff and so on that were involved should have made more inspections and contacts with the situation on Bataan, rather than being an independent sort of island apart.

Q: How did MacArthur take the reverses of that fighting and the almost certain defeat of his forces? Did this have an adverse effect on him or was his morale relatively good throughout the fighting?

A: Well, I think his whole inner nature made him capable of withstanding that. I guess any commander would sort of resent it and be disappointed. But the answer was inevitable. I feel there was just no possibility at all of the Bataan-Corregidor force holding out forever.

Rations were short; we were on half-rations on Bataan. We had a light breakfast, a light supper, but no lunch. And our ammunition supplies and other supplies were dwindling. We had an outbreak of malaria. We had no quinine nor atabrine, and the troops were getting weakened with hunger and disease.

My headquarters was very busy with continuous inspection of defense installations and making suggested changes. We were also being subjected to air raids and some enemy action, although then relatively light up at the front. The only principal action, I think, was one where the Japanese made a landing on the coast behind our left front. There was a threat of cutting off the west coast road forward, and the reserve commander utilized any forces around that area, including our 803d Engineer Aviation Company. They were thrown into this combat to push out the Japanese who'd made that landing. They were not especially trained for combat and they incurred rather heavy losses, so much so that it almost destroyed the effectiveness of that unit. As a matter of fact, I did make a protest about their use for that purpose because there was a critical need for our engineers and their equipment. To use them, rather than some other infantry elements in the reserve force, to push out this enemy force that made the landing I think was sort of a waste of critical manpower. In fact, after that operation we moved the remainder of the company over to Corregidor to reinforce the engineer troops there while being rehabilitated.

One of the things, though, that we did was when the Japanese made the landing on the coast and took shelter in some caves in the coastal ridge. One measure that we used was to get a case of dynamite, lower it to where the cave was, explode it and hit them that way. I also got some small boats and got some sheet iron that had been used for water tanks, and used that as temporary armament on these boats so they could approach and fire on the enemy elements sheltered in the coastal ridge areas. They were relatively effective. Later on, however, a couple of them were bombed by Japanese aircraft.

Q: Could you tell me anything about the exploits of your little engineer launch, the *Nighthawk?*

A: *No,* I have nothing special, I think, to report about that.

Q: I was wondering if there was something unusual. Apparently you did do a few things with that little launch.

A: I believe that was one that I used to move from Manila over to Corregidor. As I said previously, I got out in the early morning of January lst. I was the last one to leave Manila. When I left, there was no one there other than one constabulary soldier. He took over our headquarters. MacArthur's own office was left intact. We had not cleared out anything, except we cleared out all the papers, files and so on, and destroyed those. But his headquarters office was left there intact. He sort of felt the Japanese commander would do with that headquarters what we would have done if we had come into their Japanese headquarters.

Q: Could you give me some of your opinions of some people who were there with you? Richard Sutherland?

A: Well, as I said previously, I indicated my difference of views in connection with his decision about withdrawing from the forward position to the reserve position. I felt that he, as well as others of the staff, could have and should have made more frequent personal reconnaissance inspections of the situation. But he was a decisive staff officer and a good transmittal officer of General MacArthur's instructions or requirements.

Q: How about General Willoughby?

A: Charles was our G-2 man. I think he was a well-trained, very capable intelligence officer. In the early phase of the war he had limited facilities to get intelligence information about the Japanese because that was mainly something that we'd have to get from outside intelligence sources, which might be in the War Department. Later on when we were in Australia and New Guinea, there we had better capability of getting intelligence on the enemy situation. There he did very ably.

Q: How about Colonel Stickney?

A: Colonel Stickney was a bit older. I think he was almost ready for retirement when the war broke. But as Philippine Department engineer, I think he was better qualified, say, for the peacetime functions of the department rather than the more active incidents and so on that would occur under combat conditions. But he and I got along very well. He cooperated excellently.

Q: Roscoe Bonham?

A: Bonham, Stickney's supply officer, did an outstanding job, particularly after the outbreak of war in connection with requisitioning of vital supplies. I gave him practically carte blanche authority to go out and requisition engineer equipment, supplies, explosives, whatnot that we needed. He did a very fine job on that. He remained in Manila the way I did after our department headquarters had moved to Corregidor on Christmas Eve. I was in constant communication with him on that mission, and he did an excellent job in commandeering barges, transportation, trucks, whatnot, and moving the maximum amount of engineer equipment, supplies, wire, explosives, small generating units, and so on over to Bataan, all under frequent enemy air raids on our defenseless open city.

Q: How about Wendell Fertig?

A: Fertig was a very able engineer and a good field engineer, too, in handling field operations. Indicative of what I thought of him was, later on after we were ordered to move to Australia to this new command, when I got down to Mindanao, we were detained there for three days. We were supposed to get out that night, but they had problems with getting aircraft to take us from Mindanao to Australia.

During that period, while the rest of our group remained at Del Monte, Brigadier General [Harold] 'Hal" George, the Air Force commander, and I made several reconnaissances-the first day down to the southeast toward Davao, then held by the Japanese; to the northeast; the next day to the northwest. We picked out potential airdrome sites. We had ambitious Plans as to what we wanted to do to prepare for hoped-for reinforcements from the south.

Knowing that their construction was going to be a critical operation, I prepared a wire from MacArthur to Wainwright ordering Fertig to be transferred from Bataan down to Mindanao, to put him in charge of the projected air construction operations there because I thought he was the best one qualified. That was a measure of the confidence I had in him.

He did go down there, and later on he felt he was there working for me. When the general-was it [Brigadier General William F.] Sharp? -issued orders that his Mindanao command was to surrender, Fertig decided he was working for me and General Sharp's order didn't apply to him. So he went off to the hills with some of his force, and recruited many Filipinos, and set up the Fertig guerrilla force. He was very effective as such in Mindanao throughout the rest of the war.

Q: How about William Chenoweth?

A: Chenoweth, although a relatively junior officer, performed outstandingly as the corps engineer with the South Luzon Force. He met every emergency and crisis. He was most effective. We had a number of civilian personnel plus those whom I had commissioned for our demolition parties and whatnot. Our demolition phase was generally over when we moved to Bataan. So we gave Chenoweth a number of these men, and they organized a separate battalion made up of these civilian engineers and those I had commissioned. We supplemented them with a few engineer officers. They then gathered up a number of Philippine civilians, the laborers over there on Bataan, and he organized them into two battalions. They were very effective in aiding in the defense construction and other work there in his area. It was relatively well done and well handled.

Q: How about Lieutenant General Jonathan M. Wainwright, who commanded North Luzon Force and then I Philippine Corps?

A: I felt that General Wainwright could have done a little more than he did. He was a cavalry officer, an ex-cavalry officer, and I think he thought in terms of cavalry charges and whatnot. Insofar as his defensive position on Luzon was concerned, I thought it was not as well done as it was in the South Luzon Force, II Corps sector.

I had hoped that he would take a more personal interest in examining his position. I don't think he covered it adequately. I know when I covered it I found that a lot of the commanders of all ranks, who should have been up to reconnoiter and observe their defense arrangement, should have been there and made corrections which had not been done. As to later on, when he succeeded MacArthur, I am not familiar enough to comment as to his conduct on that situation.

Q: What do you remember about Major General George M. Parker, who commanded South Luzon Force and then II Philippine Corps?

A: I didn't have too much to do with him. I thought that he commanded his force quite well, both on the withdrawal and also on the situation on Bataan.

As I said, I felt that General Wainwright could have been more personally involved during the withdrawal phase of the North Luzon Force and later on the defense situation there on Bataan. But General Parker seemed to have the situation well in hand.

Q: How about Major General Edward P. King, Jr., commander of the North Luzon Force after Wainwnght?

A: I thought General King was excellent. He was the artillery commander. In fact, I think most of the casualties inflicted on the Japanese during the early stages of our defense situation on Bataan were inflicted by the artillery. I think they were the factor that withheld the Japanese forces most effectively.

It just seemed tragic to me, though, that when they withdrew to the reserve position, it reduced the capability of the artillery against the Japanese to a greater degree than the artillery could perform under our forward position in controlling the approaches to our defenses.

Q: How about Brigadier General Harold George, air forces commander after Brereton?

A: George was outstanding. He and I had a very close relationship. He was initially in command of the pursuit air force—very conscientious, very active. At one time when we were on Bataan he conferred with me and Commander John D. Bulkeley on a proposal to ship the Air Force pilots to China. We had no planes and we thought it would be feasible and desirable to send these pilots by PT boats over to China so they could join our American Air Force over there. But that proposal was squelched. But George and I worked very effectively on Bataan in connection with our joint Air Force situation and also during the early stages down in Australia and New Guinea until he unfortunately was killed in an air accident at Darwin. In fact, the time that he was killed he and I were supposed to go on that same trip together. But things came up and I had postponed it or changed it for a mission that I had to take in New Guinea.

Q: He was a very excellent air officer?

A: Excellent, excellent.

Q: He is one of the air officers about which very little is known. Unfortunately, he doesn't receive the credit he should have.

A: Unfortunately, he didn't have too much time during the war because of his unfortunate earl y death. But I think we would have heard much more of him in the event he had continued to live and operate.

Southwest Pacific Area: Australia and New Guinea

Q: When and how did MacArthur tell you that he was ordered out of the Philippine Islands and that you were going to go with him?

A: I was advised by General Sutherland in one of my frequent trips over to Corregidor. As I say, I was on Bataan all the time. I'd make a trip over to Corregidor at night, check up on the engineer situation over there—utilities and reconstruction of the bombed, damaged utilities, and so on—and also on our small airfield that we had up at Corregidor, engineer problems such as that. It was then that I was told by General Sutherland that I was to accompany the group.

Q: What was your reaction when he told you that?

A: Mixed. We sensed that it was impossible to hold out forever. **We knew** that we were not going to get any major reinforcements. But we thought that this would be an opportunity for General MacArthur and the staff-going down to Australia-whereby we'd have access to planes and forces, and in that way we felt that we had a greater chance of getting reinforcements back into the Philippines, hopefully rescuing our command before the situation was completely lost.

Q: You left Corregidor the night of March 12th in a PT boat headed for Mindanao. Could you recount what your trip was like?

A: There were four boats. Mine was the last. Three of them had taken the personnel from Corregidor and the fourth came over and picked up those of us on Bataan-and there were very few, incidentally. We proceeded through the night, with blackout because the Japanese controlled all the intervening waters. Our boat, which was the last, during the night conked out with motor trouble. We fixed it up. Having lost distance, we restarted with maximum speed. Again, the motors failed, but finally we got them going. Then early the next day, just as dawn was breaking, we were approaching a little spit of land and our commander looked back and through his scope saw this vessel approaching us. He shouted, "A Japanese destroyer is headed down on us. "

He said something to me and General Akin [Brigadier General Spencer B. Akin] -we were the senior officers aboard-like 'Shall we oppose? If so, it may mean the lives of the men and the boat. " Well, we had gotten that far and we said, "We certainly will. " So he got out a knife and personally cut the lashings that held the drums of gasoline on the deck. We needed this extra fuel to get to where we were going. He dumped those overboard; the crew manned our machine guns, got our torpedoes ready to function; and he kept observing with his glasses this approaching boat. Suddenly he said, 'That's not a Japanese destroyer. That's one of our boats. " Well, it happened to be the boat with General MacArthur and his family on it, and we were getting ready to sink them to the bottom of the drink. Well, they continued on up to us, dodging some of the drums of gasoline we had dumped, and came up alongside. We had a little conference.

General MacArthur conferred with me, and he decided that I should move over onto his boat with them and we would then continue to proceed even in daylight as we were then far short of the scheduled rendezvous point. So we decided we had to proceed in daylight in order to get down there. We did. When we arrived there, we found only one of the other two PT boats. It was decided then to leave the PT boat that I had been on to await the arrival of a submarine that was due to come under an option to take MacArthur and his family, not all of us, on the submarine and proceed to Australia.

We had a short conference and urged that he continue by PT boat down to Mindanao, rather than by submarine, which he did. Bulkeley then left our PT boat there with instructions to await the submarine and then to proceed to Cebu. We continued on in our two boats. Unfortunately, the commander of the PT boat, when the submarine arrived, said his boat was disabled, and they jettisoned and sank it. And he and his crew got on the submarine and went back to Australia. Commander Bulkeley, when he later learned of that, was very irate over it.

But we continued on and, due to the fact that we had taken so much more time than scheduled, proceeded that afternoon before dusk instead of waiting for the darkness of night. Shortly before dark we looked ahead and here was a Japanese cruiser, this time a real cruiser, headed east as we were headed south. We swerved over to the west, hoping we would not be recognized; maybe they would figure we were two Philippine fishing boats. In any case, the cruiser proceeded on and its commander missed a wonderful opportunity to capture General MacArthur and his staff.

After that, we proceeded without further incident to Mindanao. Near Del Monte we were met by General Sharp, American commander of Mindanao, and his staff to await planes to proceed from there to Australia to the new command.

Q: What was General MacArthur's attitude during the trip down?

A: I think he was concerned over the safety of his family. Otherwise, I think he was acting normally. I was surprised, though, when I sort of sensed that he was seeking my advice in connection with whether to proceed by submarine or continue further, because he asked questions along that line.

I urged him to continue on. I was sort of surprised at that because he was a man of decision, and he usually didn't ask for suggestions or advice such as that.

Q: Why did you think he should continue on the PT boat?

A: Well, that was our objective, our mission. I thought it was the thing to do. And I felt we could make it successfully.

Q: When you arrived in Mindanao, you were supposed to have been met by B- 17s sent north by Major [later Lieutenant] General George H. Brett, who was commanding general of Army Air Forces in Australia. But you only were met by one usable B-17 at Del Monte. MacArthur apparently got very disturbed at this. What was his reaction to this episode?

A: Well, I guess he was quite disturbed, based on other reports rather than as I noted directly. But anyway, General George and I thought that this was a wonderful opportunity for us to survey the situation there. While the rest of the members of the staff-General MacArthur and the others—stayed there waiting for the replacement planes, we utilized three days in making reconnaissances, seeking out potential airdrome sites. What we hoped to do was to provide facilities for planes and other reinforcements to come to Mindanao en route to the Philippines.

Q: Do you think that Brett's slowness in getting those planes to MacArthur affected their relationship once MacArthur got to Australia?

A: That possibly was a factor. I don't know what the reasons were that Brett had for such a delay. But I know General MacArthur was quite irate and impatient. I think Brett would be the individual target for such feelings.

Q: There are comments that Brett's bad relations with MacArthur were partly caused by that and partly caused by Brett's slowness in coming to see MacArthur once he reached Australia, that he did not come and see him quickly enough.

A: I don't know anything about the latter. I think that MacArthur felt that Brett was operating more on sort of a peacetime administrative basis rather than, say, under the wartime atmosphere that prevailed under combat conditions up in the Philippines. Possibly some of that I think MacArthur resented, and it came out possibly in his feelings toward Brett as an individual.

Q: Brett and MacArthur apparently never got along too well.

A: I don't think they did too well.

Q: What was Brett like?

A: He was a likable person. I didn't personally have too much contact with him. My main relationship was with General [Brigadier General Dwight] Johns, his engineer deputy, because I was concerned primarily with the engineer situation—what we had to do and what we could do.

Q: Did you have any occasion to meet or know Air Force Brigadier General Henry Clagett, who was up at Townsville?

A: Yes, but not too much. He seemed an older officer, less virile and less active, certainly compared to General George. But he gave the impression of being a good, solid type of officer. He was one of the older officers of his rank. I sort of liked him with the few contacts I had. I didn't regard him as somebody that was outstandingly capable, alive, and active and so on, but he seemed to be a good solid type, an old-type commander.

Q: You were mentioning the work of the Australians at Port Moresby when you went up there with Harold George.

A: They were engaged in what I would consider more permanent type of construction rather than the expedited construction to meet the immediate requirements. After all, it was not necessary to make concrete runways and the other refinements that would go with permanent construction. It was a matter of getting a usable runway and taxiways and dispersed hardstands that would be operable, especially during the dry season that we were then experiencing.

Q: This seemed to be a major problem with the Australians; that is, that they wanted to build facilities that were of a more permanent nature, looking forward to the postwar period, whereas the Americans wanted to build temporary wartime facilities to serve tactical needs. Did you ever resolve this with the Australians?

A: Gradually. For one thing, we developed standard plans for various types of structures and issued those; they were to conform more to temporary type construction of facilities, seeking to utilize to the minimum materials and manpower and so on and yet meet the need.

Australia estimated there was a strong possibility of a Japanese invasion. They had a coastal railroad that went along the east coast, and just inland they had two other sections of parallel railroad, but with a 300-mile gap between these two. The Australians, figuring that the coastal railroad might be cut, wanted to build a railroad for the 300-mile section or so connecting these two interior routes. Well, I opposed that most strongly and successfully because it would have been a diversion of manpower, materials, and equipment for that. Ultimately, in peacetime it would be very useful.

Another problem I had was that each province had a different gauge for its railroad, which meant, for example, that when you came to the Queensland border, you had to transfer supplies to a train that operated on a different gauge track in the adjacent province. There was a strong movement in Australia at that time, even with the war on, to try to change the gauges to a uniform size throughout Australia. And that would have been a terrific diversion of manpower and materials, and also we successfully opposed that. Also, on the road to Darwin, the railroad went up part way, I think up to Alice Springs, and there was about a 600-mile gap to the next branch. Then you had rail on up to Darwin. So there was strong pressure to build the railroad in that intervening gap. We also successfully opposed that.

But by and large, though we had such differences in their desires to get such useful peacetime projects under way, we were successful in stopping them and keeping the construction program, with its utilization of materials and manpower, primarily limited to the war requirements.

Q: How quickly did you realize that in the Southwest Pacific you were going to have to scratch for every piece of equipment and the materials to do your job?

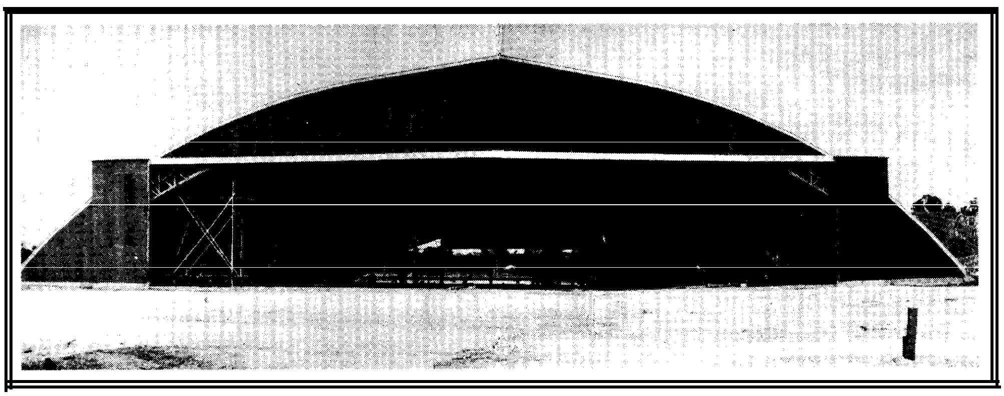
A: We sensed it right away. For instance, we relied not only on equipment that we requisitioned from the War Department, but we went around and requisitioned and obtained tractors and machine equipment of all different types that were in use in Australia by contractors, by others, and from the different equipment dealers. We made mass requisitions for any type of such construction equipment we could get. That meant we had equipment of different sizes and of different manufacture. We had a terrific spare parts problem trying to maintain these different items of equipment. But the need was so great that we just had to get as much of everything of that nature as we could. Recognizing the limitations on shipping, we requisitioned motors for tractors and assembled them in bulldozers and carryalls from parts made by Australian production.

Q: You adopted all kinds of expedients-substitutions, scavenging, improvisation —in an effort to get your work done. Why do you think the War Department or General Reybold's office was not more understanding of your needs and provided greater assistance?

A: I think they possibly were moderately acquainted with our needs. But they also were acquainted with the needs of the European Theater. The decision had been made that the European Theater was to be given first priority in the allocation of supplies, equipment, troops, personnel, and whatnot. We were sort of on the end of the line, so that we had great difficulty in trying to get the things we needed and particularly as quickly as we needed because the need was so great.

You were speaking of improvisation. At that time the Air Force wanted a camouflage cover or protection in our hardstands for their airplanes because of the air superiority of the Japanese force. So in connection with getting camouflage nets over big planes in the operational areas, it would be a difficult problem as to how to provide them.

We also needed many structures for temporary depots and storage areas. So I came up with the idea, along with two Australian civilians whom I got to know, and we designed a so-called igloo which was made up of arched frames assembled just by 2x4s, instead of using steel structures and concrete. We were able to make an arch frame made only of small-sized timber. We would make these structures 60, 100 feet or whatever length was necessary and use them as supports for camouflage nets, but more particularly we used them in the depot construction throughout Australia and later on through New Guinea as need developed for structures of that type. In that way we were able to utilize locally available timber and manpower and develop very effective, economically built structures.



Igloo hanger, Archerfield, Queensland, Australia.

Q: You were mentioning your reconnaissance to Port Moresby. Could you describe MacArthur's reaction to your report when you delivered it?

A: Well, he asked me what I thought of the Australian combat troops that were there. I said I thought they were excellent. I reported about the tremendous amount of engineering work that had to be done. We had to increase the port. We wanted to use that as a base.

We needed, I don't remember if it was four or five, airdromes around the Port Moresby area. Shortly after, I made a trip down to the Milne Bay area and met with the Australian combat forces there. They had no airdromes and only limited port facilities and roads. I figured that we had to develop that port as a big base and also construct three airdromes down there. We made a plan for the construction of three new airdromes in that area because it would be the most vital point for the protection of Port Moresby and all of New Guinea. I decided to rush part of our limited engineer force down there.

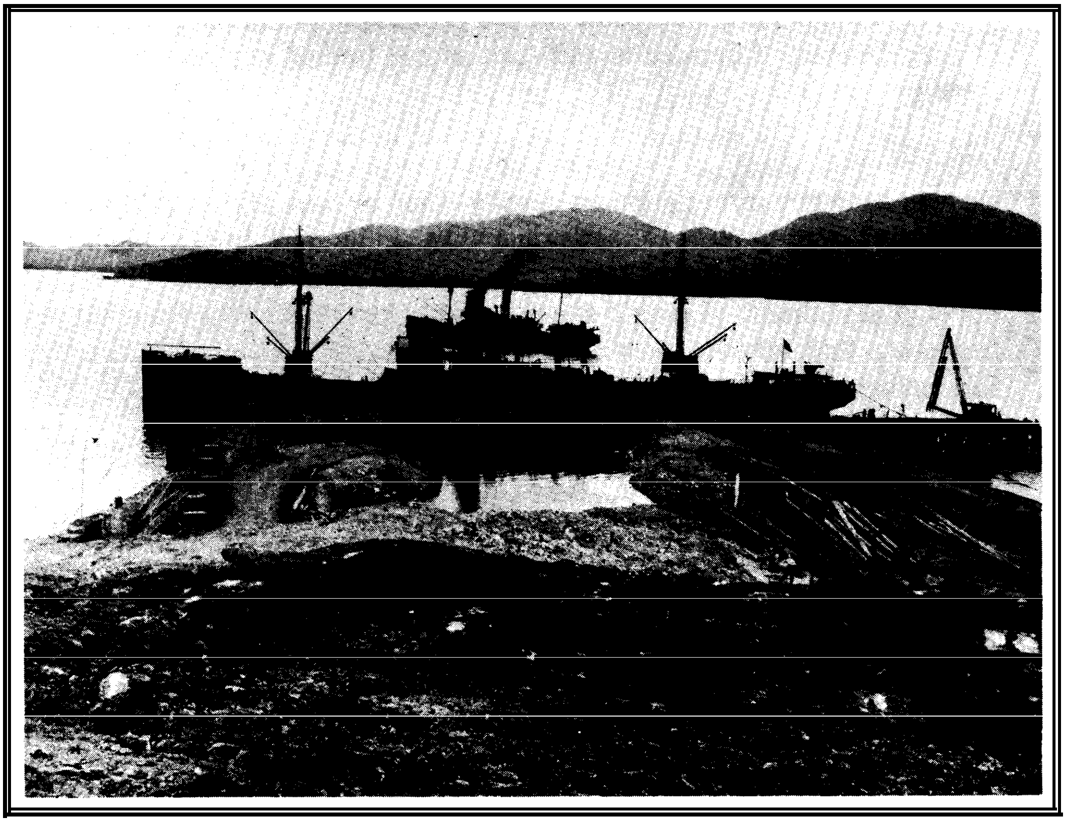
Q: Do you have any information on exactly when or how MacArthur made his decision to hold in New Guinea rather than to fall back into Australia?

A: I would say almost-I won't say overnight, but practically from the very beginning that was in the back of his mind. I mean, it was probably formulated in the very first contact we had with any of the Australian force leaders.

Q: The order to hold New Guinea was not easy because the immediate operational requirements had to be balanced with long-range plans to develop the theater and the bases necessary to conduct operations against Japan to recover the Philippines. How did you go about trying to balance the operational requirements for engineer construction and forces against this long-range need?

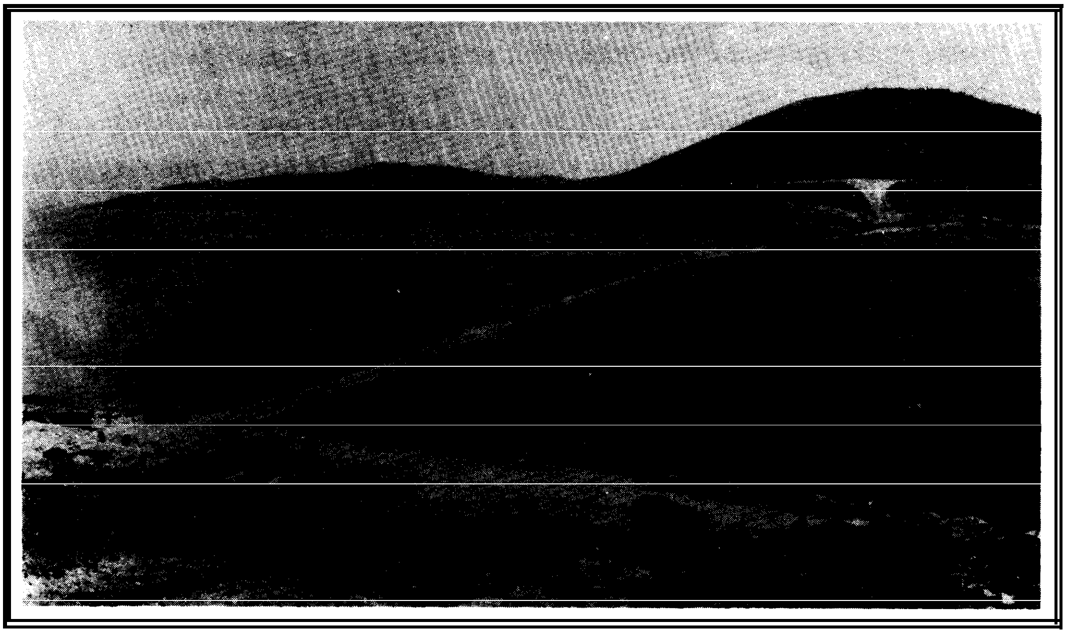
A: The long-range need I think was far away. The immediate need was a matter of highest priority. All we had were two white general service regiments, the 43d and the 46th, and the 808th Engineer Aviation Battalion. We had two colored separate battalions [91st and 96th Engineer battalions] just made up of black labor troops. They had no equipment, very few officers. In order to increase their capacity to perform, I sent a radio [message] to the States for authority to transform them, in name anyway, to general service regiments. That meant we could get more authorized white officers. It meant also we could get more authorized equipment. With that as a base, we had a better chance of getting equipment that we direly needed. We then also assumed a big training job to convert them.

We had only one engineer supply company for the whole theater. We had only one maintenance company, whereas there was a need for many, many more. I put on my emergency requisition list our needs for the troops we needed, but we couldn't get them. In some cases they weren't even available back in the States. They hadn' t provided to organize or train them in the overall mobilization plan. Their objective seemed to be to organize and train combat divisions rather than a balanced force.



General view of the Tatana dock being constructed by the 96th Engineer Regiment, Port Moresby, New Guinea, 27 July 1943.

But we had to use these forces, spread them thin over the work program there in New Guinea, in Port Moresby, Darwin and Queensland, and at Milne Bay. In order to increase the capacity of the port at Port Moresby, we built additional docks. Over the objection of the Air Force, because they thought this was a diversion of construction effort from airdromes, which they considered the only and primary thing, we built a causeway over to Tatana Island and there we developed a number of additional docks, as it was vital to have sufficient port capacity to get the stuff in to build and support these airdromes. That greatly increased the capacity of Port Moresby as a port to receive supplies. At that time the Japanese had great superiority in the air so that any air flights in and out of Moresby had to be made at night and planes would also have to take off at night in order to keep from possible bombardment by the Japanese air forces.



Tatana Island causeway, Port Moresby, New Guinea.

As I indicated, the need was for developing airdromes and developing a base. But after we had built up a small American complement, it was decided to set up a small hospital unit there at Moresby to take care of casualties on the American troop side. We got word they were going to send over a contingent of nurses. Prior to that time all of our troops were operating in the open and the latrine facilities were also all in the open. We decided that with nurses coming we would have to give them a plush-type latrine. So we fixed up a small screened structure with boxed seats and finished it just about the day before the nurses were due to arrive. They came in by plane at night. The next morning they found the need to utilize this new latrine we had furnished. Well, to indicate how the American soldier does not lose his sense of humor even when he's working around the clock, our engineer boys set up a loudspeaker in the trench below the row of seats and they were over in the woods watching. When they thought the place was quite full, over the loudspeaker from below came the message, "Will you please move over? We're working down here. "

Whereupon there was great screaming with the nurses all leaving. The chief nurse later put in a complaint about that, but it indicated how the engineer, particularly the engineer soldier, the American soldier, even under great stress, working around the clock, still retained his sense of humor.

Q: You emphasized in your article about military engineers at war that it was essential to have a sense of humor in wartime conditions.

A: Yes. I mean, if one is going on under stress and tenseness and can't occasionally see a little bit of humor out of some of the situations that develop, you don't have a measure of relief from all of that tenseness under which you otherwise would be. I listed a flock of characteristics that I thought the military engineer should have. That's one of them.

Q: Do you remember any other little stories like that that come to mind particularly?

A: Not that I can think of right now. Probably you can find some in Sam Sturgis's correspondence between him and me or Sam with others. But we found lots of jokes about certain incidents, little humorous commentaries about people, about events.

Q: Despite the fact that airfield construction was the number one priority both in New Guinea and in northeast Australia, the Allied Works Council was reluctant to send men into those areas to work. You finally had to rely upon the Queensland government to help you with Mareeba and Cooktown Mission airfields.

A: The Allied Works Council was not unwilling, I think. It wasn't a case of their being unwilling to send their personnel to New Guinea, but we just didn't particularly care to have Allied Works Council send their personnel to New Guinea. They were older men, primarily workers and not qualified for combat and so on. I think it would have been difficult for them to operate under the conditions that obtained in New Guinea. What we were concerned with was getting the Allied Works Council to take over the work that was being done by our engineer units on the mainland, including those in the more advanced or exposed areas, such as up in North Queensland and the Darwin area. That was where we had to exercise a little more pressure to get them to take over those projects.

But as I say, in order to do it we used the provincial governments like the Queensland government. We just used every means possible we could to get manpower to do the work that had to be done. We worked with the principal objective of having the Australians take over all the construction work in Australia just as quickly as they could in order to release our troops for more vitally needed work over in New Guinea.

Q: Besides their lack of equipment and their lack of training, what else stands out about the 91st and 96th Engineer battalions?

A: Well, first of all, they had been recruited, trained, organized merely, you might say, as supplemental labor. They were given no special engineer training. They had no special engineer construction equipment. They had relatively few officers compared to the large sizes of their companies, so that their management and their control were difficult problems.

As I say, our need for equipment and a basis for getting equipment were such that I felt if we transformed them to general service regiments by name—now that didn't make them individual y qualified-it did give us more officer personnel and it did give us a basis for getting equipment, whether they were going to use it or somebody else was going to use it. Ultimately, we got to where we were training them and they worked generally as an effective unit—not nearly as much so as the basic general service regiments or the aviation engineer battalions and other trained engineer units.

Q: Although your engineers worked hard on the airfields, you couldn't satisfy the Air Force commanders. Why didn't they understand the problems facing you in building serviceable airfields in the conditions of weather, terrain, lack of equipment, and lack of trained personnel that you then had?

A: Well, because the Air Force—at least the leaders then—felt that in their minds the operation of the Air Force was the most important factor in the conduct of the war, certainly as of that time. They kept pressing, pressing, pressing for these airdrome facilities. They wanted extra taxiways. They wanted dispersed hardstands. They wanted camouflage cover for these. They wanted large mounds around each as further protection from air raids. They wanted these big revetments, for example, around each one of the dispersed hardstands. Well, that meant a great big mound of earth all around. These, of course, called for a tremendous amount of extra construction.

In order to service those airdromes you had to have roads to them. You had to have ports to bring supplies and equipment in. You had to have other facilities, like water supplies, certain types of utilities, pipelines and oil tanks to get the fuel in in the quantity which they would require. But somehow or other, they couldn't sense that those other things were as important as work on their own individual airdromes.

One particular problem we had in the early part was they wondered why we didn't go in for, you might say, permanent construction so that these airdromes could withstand heavy traffic during the coming rainy season. At that time it was the dry season. I felt that the need was more vital to get two or three operating airdromes then than one, you might say, all-weather airdrome.

I had to fight General Whitehead [Major General Ennis C. Whitehead, Commander, Forward Echelon, Fifth Air Force] in particular on that. And I said, "If, as, and when we're here during the rainy season, we'll have these strips, certain strips, prepared adequately to operate under such conditions. But as of now, our main need is to get the maximum amount of operable airdromes, possibly under reduced standards."

One thing that was important, and I had to personally impress it on all of our engineer officers, was drainage. Somehow or other, in working they'd build an airdrome or whatnot but not give sufficient attention to drainage. I had to point out that if you can lower the water table by a foot, it's much easier to do that than to put in, for instance, an additional foot of field cover which in turn would subside. I just tried to point out the very simple doctrine that water flows downhill and can be released by drainage. I prepared personally a short technical memorandum. I issued it to all of our commands, and I directed that it be read to every officer and every NCO and every engineer as a measure of stressing the importance of certain fundamentals such as drainage, which is an important factor in the construction of airdromes as well as roads and other features.

Q: The Battle of the Coral Sea in early May 1942 must have caused some anxious moments for MacArthur as well as yourself?

Muddy and rough roads made transportation difficult. Saidor, New Guinea, 18 January 1944.

A: Well, we felt a little confident about that. I don't know that we were too perturbed about it. I mean, it wasn't like Pearl Harbor where they popped in and unseen and unnoticed effected great destruction. We went out prepared for what was expected. That was primarily coming from the Central Pacific area, not ours.

Q: Once the Japanese were beaten back at the Battle of the Coral Sea, MacArthur ordered Leverett Yoder to Abau and Milne Bay in May of 1942 to survey for possible airfields so that they could establish a presence in northeast New Guinea and Papua. What were your actions in helping get the plans approved for the move to Milne Bay?

A: I don't know about General MacArthur ordering Yoder to go down there. I mean, after all, Yoder was under my command. I think I'd have issued such orders to him. I think he was sent down to Milne Bay. Abau came at a time just after the Japanese had made a landing in New Guinea and after General MacArthur approved my recommendation, counter to his prior order to build the road over the Owen Stanley Mountain Range from Moresby to Buna.

Although we had contemplated developing an air base in the Buna area, before we were able to get forces up there the Japanese had landed. They had taken a position there. Then they were marching and advancing over the Owen Stanley Range, threatening Port Moresby, which was held by the Australian troops.

General MacArthur said, "We have to build a road from Port Moresby over to Buna. " He called me in. He said, "Pat, we want to build a road with the greatest speed possible from Port Moresby over to the Buna area. "

I was surprised at that because I had thought the rugged Owen Stanley Mountain Range was the best defensive feature that we had to protect Port Moresby because the Japanese had to come through rugged jungle and over extreme heights and whatnot. I also said it would require a great diversion of engineer effort and affect our whole development program.

He said, "We want to build that road. " So I said, 'I'll submit a plan. " The next day I submitted a plan and draft chart indicating that we had to divert practically all the engineer units that we had from other vital airdrome construction at Milne Bay and elsewhere to do it, and indicating how it could be done with the great effort involved. At the end, I said, 'Sir, I still recommend that we not build the road, because as it is now it's also one of the best defense features that we have for the control of Port Moresby, and the continued construction of these other facilities is more vita l."

After listening, he said, "Pat, your logic is quite sound. We won't build the road. " That's one time I got General MacArthur to change the orders he had given me. But he decided then it was desirable to get some form of access across the range. They thought there was a possibility of developing a port at Abau, farther east, and wanted to check the potential road conditions across the Owen Stanley there to the north coastal area.

Jack Sverdrup, my deputy, and I proceeded there to Abau and assessed the situation. He made a trek across the mountains and submitted a report indicating the great difficulties of such road construction. He came up with the recommendation that instead of building such a road there, we develop some native-built airfields in that general route, which we could easily and readily develop. And it was decided that we would utilize that method. Those fields, as well as several later ones at Bena Bena and Mount Hagen in the Markham Valley, were built by native labor and hand tools largely under the direction of Mick Leah, an Australian officer on my staff who had lived for many years in New Guinea and knew the native language and customs.

Q: Did General MacArthur have a firm understanding of the engineering problems confronting you?

A: Well, I don't think anybody other than those who were directly involved would have a real appreciation of the problems and difficulties. But I think he sensed it generally.

I know he thought particularly highly of us. I recall one day he came in while General Kenney [then Major, later Lieutenant General, George C. Kenney] and I were in discussion. He came in, threw his arms around both of our shoulders, and said, "How are my two aces today?" Which I thought was a great tribute. He had been an engineer officer, and I think to that extent he had a greater appreciation of what the engineering problems were than possibly if he had been a commander who had come from the infantry or some other branch.

Q: You mention George Kenney. What was your opinion of George Kenney?

A: George was an able commander in the capacity in which he served. He was very forceful, very direct, quite blunt, obstinate, and persistent. I think he was fortunate, too, in having General Whitehead as his subordinate commander, commanding the Fifth Air Force. I thought that General Whitehead was a little closer to the situation, closer to his fly-boys. He was working night and day. His one interest was in the Fifth Air Force, and he was very insistent on his demands on the engineers and he kept pressing, pressing, pressing. But General Kenney, as senior commander in overall charge, had a good relationship with General MacArthur. He was a very fine senior air commander.

Q: Apparently General Kenney was able to correct the damage that had been done to the Air people by the relationship that George Brett had established.

A: Yes. The relationship with Air and GHQ was a very good one. Sometimes there were individual differences. Somehow Whitehead sort of felt he had strong differences with Colonel [A. G.] Matthews. Colonel Matthews was in the Port Moresby area and handling much of the airdrome construction there. Mattie was a very firm, independent person. A couple of times they had rather strong differences, so much so that Whitehead wanted to have Colonel Matthews relieved. We all felt that Whitehead failed to appreciate the tremendous engineer effort required to develop the vast airdrome installation with our limited resources under the intensified time schedule desired. But Mattie was a wonderfully able worker. He also was prone to spurt out some words he might have regretted later. I used to say that Mattie could do very effective work and then in a few minutes of saying the wrong thing he could sort of lose the advantages of everything well he had done. Some of these expressions were his own worst enemy.

Q: You had a lot of trouble with the Air Force people wanting more permanent-type facilities and also wanting to gain control of the engineer aviation battalions. You remained very firm in your conviction and convinced MacArthur that construction had to remain under one agency and that would be controlled by the chief engineer.

A: Yes. General Kenney particularly-and Whitehead, too-wanted to have some of the aviation engineers. Figuring that the aviation engineers were sort of part of the Air Force, they felt they should be assigned to them and operate directly under their control. If they had been, I think they would have been used somewhat on maybe building Air Force clubs and certain other refinements for better quarters and whatnot, which we were not providing because we felt that efforts should be concentrated on the main operating essentials.

I know that these issues came up so frequently that one time George Kenney put in a letter to our headquarters requesting the assignment of certain aviation engineer units. I wrote out an endorsement, rather lengthy and for General MacArthur's signature, indicating what the policy would be.

I pointed out that airdromes were but one item—that in order to get an air base, you needed roads; you needed port facilities; you needed port improvement; you needed petroleum tanks and pipelines; and that it was necessary to have priorities as to whether it was going to be roads, ports, or whatever it may be dependent on greatest initial need. It was necessary to centralize the engineer units, the equipment, and whatnot so that they could be allocated to where the need was greatest, where the priority was greatest.

I pointed out that, for example, insofar as the Air Force construction was concerned, we had far more of other than aviation engineer units engaged on that construction. We had general service regiments and others as well as the aviation engineers. In some cases, Navy Seabees were also engaged on that, but under my centralized control.

So we indicated the policy would be that all construction forces would be unified, would be utilized where they were most needed. We said, insofar as aviation engineer units were concerned, as and when air facilities were completed and we had the forces available, we would then assign some limited aviation engineer units to the Air Force, but only for the maintenance and so on of these completed fields. That would be very minor and the priorities were such that almost never would we be able to have excess aviation engineer units. But anyway, it was signed by MacArthur. That settled that issue once and for all. Kenney had to accept the fact that the aviation engineers were not just for the Air Force but part of the overall construction effort.

Q: Who came up with the idea of establishing the United States Army Service of Supply (USASOS) setup in the Pacific, and why?

A: It was decided, I think, by headquarters, by general headquarters, I think particularly by General Marshall, who is sort of a G-4 type and had been deputy to Sutherland. He was a supply-type man. I think he was the one. I think it was a proper type organization to have in any case. But knowing he was going to head it, I think he was primarily concerned in having it set up. It was a desirable and proper command.

Q: Did its establishment alter your situation any?

A: Not particularly. At first I was also chief engineer of USASOS as well as the GHQ command. Later, after I had asked for Tenny Ross [Colonel Lewis T. Ross] from the States, he came and I resigned in his favor. Tenny was chief engineer of USASOS, and I remained on my one principal job as chief engineer at GHQ.

Q: What was Richard Marshall like?

A: Marshall was, I'd say, primarily an administrative logistics type. He wasn't a combat type. He was slow and mild-mannered in talk and manner. But he served very well in that field of service and supply. I think that was his special characteristic in the overall matter of responsibilities and duties and whatnot.

Q: Did the situation change with the service and supply when General James L. Frink took over?

A: I think Marshall came back as deputy chief of staff at our headquarters and Frink became commander there. Frink carried on very well as commanding general of USASOS. I think he had a concept of what its mission was and handled his responsibilities very well. One concern he had was getting the proper personnel to be the base commanders and getting personnel for his staff. But I think he handled it very well.

Q: Despite MacArthur's order that US Engineers' Service Command in New Guinea did not come under General Sir Thomas Blarney, who was in command of the Allied Ground Forces, Major General Cyril A. Clowes overruled Matthews with respect to some construction work at Milne Bay. MacArthur had to then establish the Combined Operations Service Command under the New Guinea force, a joint US-Australian organization with Dwight Johns in command. There must have been severe problems then of coordination in New Guinea on the construction aspect with the Australians that led to such an order?

A: Yes. We have to keep in mind that in this initial phase the only forces that were in combat with the Japanese over in New Guinea were the Australians. And General Blarney was the Australian commander-in-chief, and those forces were under him. When our first American units went over, they were not combat units. The first units that went over to New Guinea were my engineer units. We got them in just as fast as we could and dispersed them to their respective development areas. So the overall command over there was under General Blarney.

Later on, as other American units came in, he still remained in command. That meant you had Australians and Americans; and then you ran into some conflicts in connection with priorities, allocation of supplies, and so on. So it was decided that we should have a joint command made up of both Australians and Americans to handle a lot of the logistics problems and service problems. We set that up and Dwight Johns was selected to head it. He did it very, very well.

Q: Could you discuss the significance of terrain, weather, and tropical diseases to your efforts?

A: You might say that that comment might apply to much of the entire theater. Few people realize Australia is the same size as the United States. You could take the United States and you could put it into our overall theater about five or six times, considering Australia, New Guinea, the Admiralties, the Borneo area, the Philippines, and on up to Japan. So our terrain was vast. That area was also unmapped and uncharted.

One engineer problem was that we had to go to great measures to handle the mapping. For instance, shortly after my arrival from Bataan I set up an early conference between the Air Force, the Navy, the Australian Air Forces, our mapping agencies, and others in setting up the common grid zone, standardizing scales, setting up responsibilities for who was going to make which maps, how we were going to control them, setting up distribution channels and so on. I was greatly pleased with the success I had in effecting an overall coordination of our highly important mapping effort.

With our terrain in New Guinea, in the operating areas up in the Philippines, and also, I think, the operating areas up in Australia, unlike Europe, we lacked maps, ports, and developed highways. Unlike Europe, we had no railroads. We had no finished highways. We had no telegraph, telephone lines. We had no utilities. We had no hardware stores nor any appreciable industrial capacity. We were in the jungle. We were susceptible to malaria and fever; and we were in an area which was subjected to intense torrential rainfall.

In our operations we were going to be required to land in a certain area which was devoid of any form of development and overnight sort of build a community for 20-, 30-, 40,000 people, build airdromes where there was nothing, hack down the jungle. The engineers' task, by reason of just the terrain and all the background conditions, was almost insuperable.

Corporal George Foster, 2d Pioneer Battalion, 7th Division, chops logs to fit into a bridge construction over a swampy area of road to Lao, New Guinea, 9 September 1943.

Q: You mention the problem of maps. As with airfields, the Air Force did not particularly understand the engineer requirements for good aerial photography.

A: The Air Force commanders were concerned with their own air operations, concerned with enemy air operations; and insofar as reconnaissance was concerned, their primary objective was to get photography of enemy air installations, finding planes that could possibly be caught on the ground, and just getting generally tactical reconnaissance photography.

Now aerial photography for mapping has to be rather precise. It has to be taken at a certain elevation. It can't have too much deviation in altitude or in tilt. In taking the photography, you want to get photos useful for maps. For some of these, you wanted maps for potential airdrome sites, for beach conditions where we were going to land and make an invasion, for base development. It was not of too much interest to the Air Force, but it was of interest to the engineers because we had to get those photographs to make maps and get them made and distributed to the affected invading task forces in *advance* of these various operations.

We had great difficulty therefore in getting aerial photography for mapping requirements. I think we finally overcame it after long, difficult problems by getting the assignment of specific aircraft for that purpose. We had to train the pilots. We set up an Air Force liaison group of such pilots with our map reproduction personnel and our map personnel had a liaison group with the aircraft pilots. We thus worked out a very good operating procedure whereby they understood the requirement and the needs and were able more effectively" to get photography where we needed it and when.

Q: You mentioned the other day that you had also known Colonel Karl H. Polifka, who was a specialist in aerial reconnaissance and mapping. Had you met him while you were down in the Southwest Pacific?

A: Yes, though I have no special recollection of any special contact or conference that we had.

Q: One of the major problems you had in the Southwest Pacific was lack of properly constituted and equipped engineer units for the requirements of the theater, which were more in the area of construction than of combat. For instance, you had too few engineer aviation battalions. You had engineer battalions and engineer general service regiments that were not really properly trained, equipped, or prepared for construction tasks. You had to retrain, convert, re-equip, and upgrade those units you did receive. How much of a burden did that place on you as chief engineer?

A: Well, I was not the one that did it individually other than by continuing specific directives to the commands and later setting up an engineer school-really a function of the United States rather than the theater. I was the one, however, who had to direct it. But the main problem I had was trying to get across to the War Department the problem and the need for additional equipment and so on. In order to get that across, we recommended numerous changes in the organization and equipment for these engineer units.

I did try to set up a theater stockpile of equipment which we could allocate and transfer to various areas as needed. But we got nowhere with the War Department. They lacked an understanding of that. They had set up this so-called supply project system. If you wanted to get a certain amount of equipment, you first had to send in to the War Department plans for the proposed operation. Say you're going to make a landing somewhere. Let's say later we're going to land up in Mindanao. You have to set up a program as to what you were going to do on that operation and then what equipment, special equipment, special facilities, and materials we'd need to support it. That would go to Washington. I think it was reviewed by the Operations Division of the General Staff and then by various supply staffs and so on. It took a long time. Generally, they'd make just a few changes, if any.

Finally, it would be approved and that would be the basis for requisitioning these items of equipment. Well, by that time that particular operation has been executed and past. All we could do then was utilize the supplies and the equipment that they had finally approved for the previous operation that was just over; and we'd have to use them for the next one, though completely different, while we were waiting approval for the so-called operational requirements for that next operation. And you should keep in mind that the engineer requirements were different for each operation, unlike, for example, quartermaster requirements for rations, which varied basically only directly with the numbers of troops involved.

There was a lack of vision as to the rapidly moving situation in our theater in that you couldn't send all the way to Washington and get prior approval for specific requirements for each operation. They should have delegated to the theater authority to assemble its own central reserves and trust in the judgment of the people out there as to what would be needed. I think that the whole supply situation would have been greatly improved had they done so.

So that was one of the problems we had in trying to get the extra equipment that we needed to reinforce these units. One of the principal ways we did it, after many delays, was to finally get approval of revising the tables of organization and tables of equipment for existing engineer units.

Q: The War Department planning structure, then, was terribly over-centralized and not responsive at all to your needs?

A: Yes. For instance, insofar as the projected invasion of Europe was concerned, here was a major operation. There I can understand that theater sending in its plan well in advance, including the basis for need for units, equipment and supplies, and so on, for steel landing mat, for petroleum tanks and oil pipelines they were going to require, requirements for fuel, and SO forth.

Here's a situation that is months ahead, maybe a year ahead of the projected operation. There is plenty of time to review it and give approval and time to procure, ship, and receive the equipment and supplies and thus get it in time for your operation. But in frequent, quick-moving operations such as we had in the Pacific, we had many operations a short time apart, that procedure was just not practical.

Q: What type of engineer unit would have been best suited for your operations?

A: Well, the construction battalions, the general service regiments, the aviation engineer battalions. However, they would all, I think, have to be modified, given some extra equipment and so on, and given extra organization and training so that you had two or three operators for each piece of equipment instead of one. It is a scandalous waste of a valuable piece of equipment, which has the capability of the equivalent of 20 to 50 units of manpower, unable to be utilized when most needed because of lack of an operator. But that was where we had to make adjustments within the theater in order to do it and to get the maximum production out of these units.

Q: You had a lot of trouble, along with your other problems, with Class II and Class IV engineer supplies. You got the same apparent response from the War Department and Army Service Forces you had in other things, which wasn't very good in meeting your needs?

A: Well, basically I think I explained that. If we had been able to build up the theater supply of what we felt we needed to have in reserve, be it asphalt, be it pipeline equipment, pile drivers, or authorization for them so we could get them when needed-because you have to remember that we were thousands of miles from the United States to the principal ports in our theater, and then up to several more thousand miles from the principal ports where they would unload to the operation areas. We had a massive problem from the time you received authority to the time you had procurement, the time you got priorities on rail transportation in the US, loading at ports, moving, in competition with other Air Force, Ordnance, Signal and QM requirements and getting it to some principal port in our theater, and then from there, getting it to some small area of projected operations. There was a great time lapse, and it was not appreciated or understood by the War Department or the supply agencies at home. There was even a lack of such understanding within the theater itself on the part of some staff, supply, and transport personnel.

Q: As chief engineer of the Southwest Pacific Theater, how much were you involved in the theater's overall strategic planning?

A: We were brought in mainly in connection with the engineer phase of such plans. The engineer phase, of course, was a vital one in practically every one of our operations. Any time we went in to any area it was for the primary purpose of establishing an air base to support a subsequent similar operation.

Usually we would pick a place not too heavily occupied or held by the Japanese. But we'd seek a potential place somewhere near it, either this side or the other side of it. We'd go in relatively unopposed and therefore requiring little in the way of combat action. The primary purpose was to establish this air base, which was basically the engineers' task.

So it was a matter of making the landing, construction of ports, if they were to be built, putting in pipelines, tank farms, roads, the airdromes, support facilities, taxiways, hardstands, and in some cases hospital aid stations, and some form of utilities—water supplies. So in connection with plans, and in particular the logistics phase of it, we were consulted and submitted our estimates and so on and our requirements to attain that task. Sometimes we didn't get all that we asked for. Most of the times we did not. But within limitations, they did support us.

Q: Since you had so many logistical problems and you frequently received units minus their equipment, you must not have been overly impressed with the operation of the Army Service Forces under Bill Somervell?

A: Well, they had a terrific task with the requirements for the European Theater, the India Theater, our theater, support to our allies, including the Soviet Union, and so on, as well as their domestic program in the American theater. But we felt in many instances that they could have done a better job.

We also felt that there was a failure certainly in the early phases of the war for the War Department in connection with its mobilization program to have the long-range view or imaginative view as to just what requirements would be. They, of course, knew that if you organize so many divisions and then you have more divisions, they could point with pride to the number of combat divisions that they had set up, organized, trained, and equipped. But a division without balanced logistic support, or any other unit without logistic support, is sort of an independent something that's not capable of its full potential.

For instance, later on we put in requisitions for engineer equipment companies, engineer maintenance companies, and of course our construction units, spare parts units. And I had to make a forceful presentation within our own theater headquarters for their inclusion in our overall limited authorization of total troop strength. But they just had been set up in the War Department Mobilization Plan only after receipt of our request. They would ultimately get approval and then they would go out and seek and try to organize and train such special units and send them out to us, but months to a year later.

Q: With little prospect of sufficient additional engineer units, equipment, or supplies, you relied heavily on improvisation shortcuts to complete your assignments. Could you discuss some of those shortcuts and improvisations?

A: One thing—I wouldn't say it was an improvisation or shortcut, but there was the matter of working the units overtime. As I say, [we doubled] the number of operators and training them so that we would have additional operators for more shifts for our critical equipment.

There'd be certain little construction procedures-for instance, in the construction of an airdrome, in not just going out and digging up fill material and hauling it on over, but we'd seek to get it, let's say, from a side hill. Instead of digging and uploading the trucks, we'd prepare a parallel road with a lumber tunnel-like structure with open top whereby you could excavate the side hill material and have it flow right into the trucks located on the road underneath the slide area.

We tried to utilize every measure and means we could. I issued a number of technical memos indicating many such shortcuts. I can't think of them right now.

Q: How useful was pierced steel plank (PSP) to your construction?

A: Outstandingly useful. For hasty airdrome construction, it was just ideal. There was a matter of clearing the site and mainly providing good drainage. But then, with the steel landing mat whereby you could spread the load of the impact of the plane coming down, it was very, very helpful for the quick construction of airdromes. Of course, it was not the solution for permanent-type airdromes, but that was not our consideration. But for operating requirements, it was invaluable.

Q: Dust was one of your thornier problems. Did you ever really solve that problem?

A: Well, in some cases where it was very, very dusty, in addition to clearing the field, we would get, say, a form of hay, put that over the cleared field prior to putting the steel mat in. As a temporary solution, it worked very well to hold down the dust.

We could not, of course, put in a sprinkler system or anything like that. But considering the fact that during our war of movement these airdromes were not being used for long periods-I mean, we had them prepared for the duration of the need of that particular base before we'd advance to the next one—measures such as that did correct it. I don' t know if we had a major problem with dust.

Q: In November 1942 Colonel Art Trudeau visited MacArthur and you trying to sell the idea of the use of the engineer special brigades. You strongly supported getting brigades for use in the Southwest Pacific and MacArthur agreed. Can you tell us a little about that?

A: Art first came to me because I'd known him before, and he made his presentation as to what the amphibian brigades were, what the potentials were and so on. I sensed that they would be vitally needed and could be utilized very well in our theater because we were going to have a lot of water movement in connection with our various operations. If we had to rely on the Navy we'd have to rely on requests to the Navy, which was not under our direct control. They had larger vessels and so on and had to have protection on their every movement, and there would be various problems.

Whereas if we had our own small floating force it could be assigned, let's say, to a task force commander, where in addition to its use in the actual landing it would be available to the task force commander and under his control in connection with resupply problems, lateral shore-to-shore tactical movements on the waters adjacent to his area.

We had a long discussion. We made up a joint submission and proceeded to report it. General Trudeau outlined it; I reinforced it; and MacArthur listened attentively and our recommendation was approved to apply for three engineer special brigades, then [called] engineer amphibian brigades. Of course, that's a sizable chunk of men, and as there was a ceiling on total personnel on our approved troop list, one had to sort of fight if you wanted more engineers or artillery or other service units within the total personnel limitation. But after our presentation MacArthur approved the request for the full three engineer amphibian brigades, as he appreciated their great potential in subsequently planned landing operations.

I might add that the Navy had been given the opportunity to organize and develop such amphibian units, but their morale had been badly shot after the loss of our fleet at Pearl Harbor and they were interested solely in the construction and development of a fighting force of large ships. Whereupon the mission of developing an amphibian force was assigned to our Corps of Engineers. Later on I sensed an envy or jealousy on the part of the Navy over the Army having its own amphibious force. Later we submitted our recommendations for other additional special units from the Engineer Amphibian Command to reinforce these brigades.

Q: How valuable were those engineer special brigades to the victory in the Southwest Pacific?

A: Extremely valuable. They were very useful in connection with the initial landings. As I say, in our theater we kept the boat and shore regiments together so that we had an integrated team. Over in Europe, as I understand, they took the boat units away and the Navy operated the boat phase of the landing operation; and all they had of the engineer special brigades were the shore units, the unloading parties and so on. But we had the boat and shore elements and they were very useful in the initial landings. The shore units were helpful not only in handling supplies and so on that were off loaded. We also trained and utilized them as other engineer units, improving roads and so on in that contact area.

They were also helpful even after the initial landings. They were then kept stationed there under the control of the task force commander so they could be utilized on lateral missions, shore-to-shore missions, in the general area because there was a great and frequent need for their use for such purposes.

Q: Bill Heavey commanded the 2d Engineer Special Brigade that arrived in Australia in February-March 1943. You then had a problem of getting their LCVPs and LCMs over to the theater. You finally solved that problem by having the boats broken up and reconstructed in Australia. Could you discuss that particular problem?

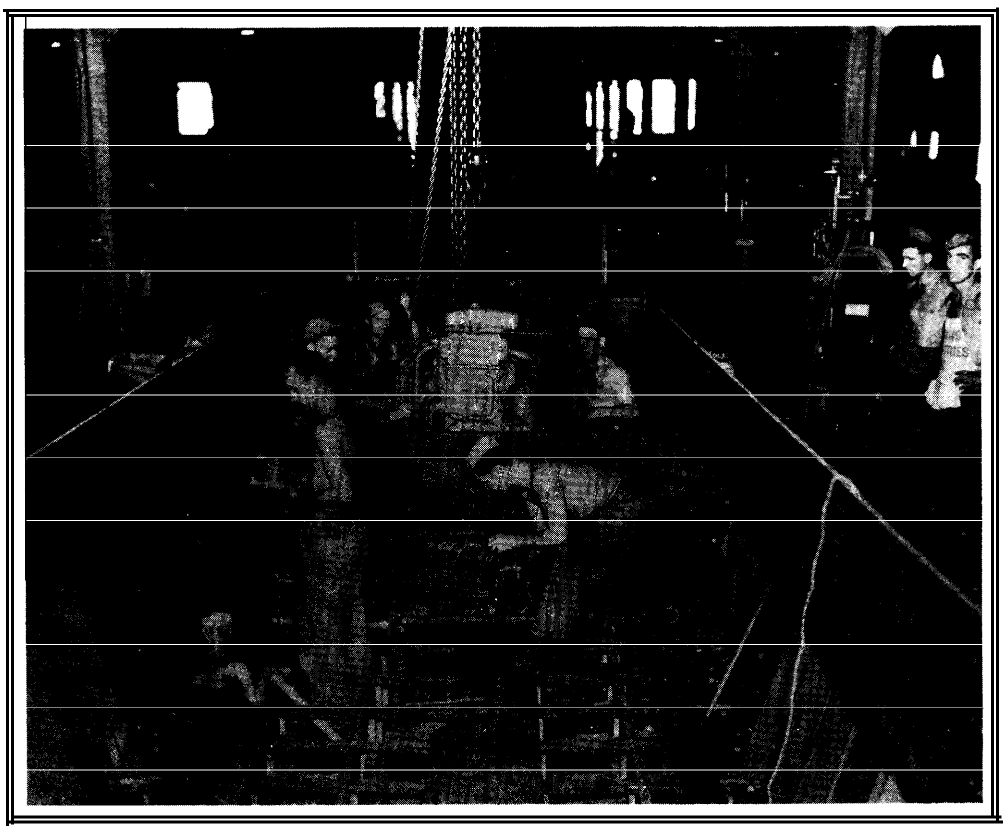
A: Transportation, of course, was always a problem. One of the particular problems was deck space on transports. There’s a limited amount of deck space for large planes, for large pile drivers and other cranes and heavy equipment. There was just so much limited space for them.

Assault boat construction by the 411th Engineer Battalion at Cairns, Queensland, Australia. Though the assembly plant is incomplete, building the Higgins boats has already started. 19 March 1943.

For instance, these LCMs would have to reshipped on the deck space, the limited deck space. That restricted the numbers of craft that we could get. So we decided if we could get these boats shipped over in parts, in sections, so they could be loaded on the ship in the hold, and assemble them out here, that would resolve the situation. We got authority to set up a boat-building command, which we set up initially at Cairns in Queensland, Australia. Then later on, as our operations proceeded further forward up in New Guinea, we transferred them over to Milne Bay in New Guinea. That boat-building command was very, very helpful.

Incidentally, in connection with the LCM, we wanted to get the maximum capacity that we could possibly get. So we decided to get an extra section, midsection, to put in there. So instead of, let's say, five sections or six sections or whatever it was, we had this additional section, about 5 feet extra length. It not only gave us greater capacity on the LCM, but by reason of the changed hull characteristics we were actually able to increase the speed of the LCM by a knot. The boat-building command boat assembly plant] was an excellent phase of assistance in connection with that vital problem. We assembled thousands of boats. I hate to think of the number that we built.

Q: What was the reaction of the Navy to MacArthur's decision to employ the engineer special brigades in the theater?



The 411th Amphibious Engineer Battalion installs an engine in a knocked-down landing craft on the assembly line in Cairnes, Queensland, Australia, 11 April 1944.

A: I don't think the Navy reaction was as strong in the theater, let's say, as I felt it was in Washington where the Navy Department sort of resented the Army taking over, you might say, what might otherwise be considered a Navy function.

We got pretty good cooperation from the Navy in our theater. In fact, toward the end of the war Admiral Barbey [Rear Admiral Daniel E.], who commanded the Navy amphibious force [7th Amphibious Force], in his reports paid great tribute to the effective work that the engineer amphibian brigades did.

I think as a result, though, possibly of some pressure on the part of the Navy in Washington, the names of those units had to be changed from engineer amphibian brigades to engineer special brigades. Of course, that was not because of anything in our theater. I think it was a Washington decision.

Q: Spare parts and maintenance for the special brigades were also somewhat of a problem because the Navy handled that.

A: The Navy handled the procurement of parts and so on for our floating craft. But it was very difficult to get spare parts. Some time later I was ordered back to Washington to present in person a number of problems I had taken up with General Somervell and his staff on their first and only inspection of our theater. I had presented a number of engineer problems and recommended solutions. So they ordered me to Washington. I took about a hundred sheets of problems that I had submitted with recommendations as to where and what action was needed. One of them was in connection with procurement of Navy amphibious craft, spare parts, and related items.

So they arranged a conference where I appeared before the Navy. I pointed out that there was a serious problem that we had there. It was difficult to get landing craft from the States over to the theater. It was even more difficult to get them up to the operating areas where they were needed. We were operating under adverse conditions. We had loss of propellers in landing on uncharted coral beaches. We had loss of various critical parts.

I indicated the special spare parts that we vitally needed and pointed out that maybe 2 or 3 cubic feet of this and that made operable a whole big landing craft, and we could get those critical parts up to the operating area where these craft were being utilized far more easily than replacement craft. So I stressed that, stressed the importance of spare parts.

During this conference some commander of the Navy was there who had been engaged on the procurement of the landing craft. He said, “We can produce landing craft; we can produce spare parts; but we can’t produce both. ” I was just shocked. But I think I did get the impression across, and I think the production and subsequent flow of spare parts were improved.

They had charts showing wonderful increased production of new landing craft. They had a chart going up and up and up. And I don’t think they wanted to reduce their record of completed craft through any added concentration on spare parts.

Q: You mentioned your trip to Washington and you told me the other day that that was the only trip you took to Washington during the war, and that you’d had an opportunity to stop by at Tarawa on the way.

A: Well, on my return I decided that I wanted to see how they were operating in the Central Pacific Theater compared to what we were doing. In my inspection of their theater, along with their engineer, I made a stop at Tarawa, which had just been taken over by the marine force. I was astounded at what I thought was a wasteful loss of life and the way that operation had been conducted, because they went right on in and went right smack into the center of the Japanese opposition. It was a most gallant but, I thought, a wasteful operation. I made a mental comparison of what MacArthur would have done. He would have landed in these small adjacent, unopposed sections of the Tarawa Atoll. And then under cover of heavy artillery fire they would have advanced flankwise. I think that MacArthur, while he would have taken a few days longer, would have accomplished that with far less loss of life and casualties-a procedure consistently employed in our theater.

Then from there I went on over and observed the operations on Roi and Namur [Kwajalein] very shortly after their landings. Those are the next two islands westward. I observed their actions. I did sense that the Central Pacific was far better loaded with equipment. Of course, they had full use of the Navy. I also sensed that their operational areas were more simple than ours.

In other words, they were on coral islands, not rugged mountainous jungle, with very good coral base for airdromes. The one problem would be water supply for a large force. But they seemed to be better equipped with equipment, personnel, naval support, and so on for their requirements than we were in the Southwest Pacific.

Q: Did the arrival of Walter Krueger's Sixth Army brighten your prospects because of additional engineer units that came out under Sam Sturgis, who was Sixth Army engineer?

A: Well, I don't think that the arrival of Sixth Army brought with it much in the way of additional engineer units. We were very, very pleased to have General Krueger and his staff in the army command to arrive out in the theater, perhaps in connection with our projected future operations. As proved out later, having Sam Sturgis and his engineer staff and so on available to handle the engineering phases of our task force operations subsequently was a great advantage.

However, I might say that Sixth Army, and I think this applies to some of the—particularly the combat units, the divisions and others that came out to us—I sensed that they had been too much immersed in what you might say was the Louisiana maneuver type of operation. Of course, in the Louisiana maneuvers they were operating in areas where they had railroads, telegraph lines, good roads, utilities, water supply, and ready access to good logistic support. In an operational theater such as ours, they'd be operating without all of that. I don't think they sensed what the problems would be without that logistic support that was already available to them during these maneuvers of the type that they had there in Louisiana. They stressed the combat phase but did not have experience or appreciation of what the logistic phase was that they would have to provide here, which was already there for them at that time.

Q: Orville Walsh and William Ely came out with Sturgis, with the Sixth Army. You've already talked a little bit about Orville Walsh. What about Bill Ely?

A: Bill was a quiet acting, relatively unassuming type of individual, but he had a keen mind. He was not one that was buzzing around all over the place;

but in a slow, methodical, careful way he was an excellent engineer officer and staff officer. He performed very, very ably.

Q: What prompted you to write your article for *The Military Engineer*, which was entitled "Military Engineers in War," that appeared in the February 1943 issue? (See Appendix H.)

A: I haven't seen it for a long time, but just glancing through it quickly, I think it was an excellent article to be considered by all combat engineers at that time with the war on.

I sensed that many of our engineer officers didn't have the proper concept of just what their functions were. I sensed that maybe some of those who were training them possibly didn't. So I tried to point out what I felt—you know, desirable characteristics that a combat engineer, military engineer should have in time of war. And I tried to point out that these are some of the things that each one could strive to attain as far as he could to make himself well qualified as an engineer officer.

Q: Do you believe that the characteristics you mentioned in your article are still important for military engineers?

A: Absolutely.

Q: If you had to pick out one of the characteristics that you mentioned as the most important, which one would it be?

A: That's rather hard to say. Assuming that you have somebody who is basically trained and has some background and professional experience, energy and conscientious continuing application to duty and effort to contribute all of his energy to the job at hand are all vital. I saw so many instances of not just engineer officers but others who just didn't seem to be dedicated enough. They'd just not do their best.

Q: The first engineer special brigade operation was on 29-30 June at Nassau Bay, and it went badly due to high waves, but the beachhead was successfully established. Did you worry excessively about the success of this operation?

A: Well, we were concerned. When you say it went badly, actually it was a successful operation. The amphibian units that went in there went in under almost impossible conditions. You had waves of—I don't know whether they were 12 feet or more—with these small craft required to make this landing. It was not their timing on that landing. Those orders and timing were issued by the high command. They went in. They performed their task. They got their forces ashore without casualties. A number of the boats were wrecked, but they were able to execute that mission under virtually impossible conditions. I think it was a great tribute to our engineers, our amphibian engineers that were involved.

Q: You had the 871st and 872d Airborne Aviation Engineer battalions, which were used at Tsili in Markham Valley under Colonel Harry Woodbury. What was your opinion of the effectiveness and the usefulness of such airborne engineer units?

A: Well, for certain types of operations where they have to be airborne to the site where they are going to work, I think they are very, very valuable units. But by and large, their equipment is so light and so small that after that phase is over and you're going to use them, say, as regular aviation engineer units, their equipment is so light and frail that you have a lot of trained manpower but the equipment is not effective in turning out mass construction under quick time.

As I say, they are a specialized unit. I think the value is—and that's their primary purpose-when you have an airborne operation into some distant, relatively inaccessible area and you land them and their equipment as they did in some of the early operations in which they were used. But later on, when it was not necessary to send them airborne, we tried every which way we could to get heavy equipment and make it available to them and use what you might say is normal-sized equipment to get maximum production.

Q: During 1943 General Eugene Reybold, Chief of Engineers, tried to gain from General Somervell a more liberal supply policy for the theater for items of Class IV supply. Did his intervention help at all?

A: Well, I don't know specifically what he was doing or what he was trying to do with General Somervell, although I had tackled him with virtually the same sheaf of problems I presented to Bill Somervell. I know that that was in line, I think, with the recommendations and so on that I had about getting away from the project supply system and instead providing, you might say, a theater reserve of supplies and equipment. It was in conformity to or parallel with the same views and objectives that I had on numerous matters as far as the engineers were concerned.

Hugh J. Casey was promoted to major general on 20 February 1942. This portrait was done by Army artist Captain John Cullen Murray in 1944.

Q: Did you know General Reybold very well?

A: Yes, I knew him very well. He had come out to the theater on inspection. We took him around, showed him what we were doing, and also stressed with him the numerous problems we had—you know, need of equipment, need of setting up a theater reserve. It may be in connection with our presentations and discussions there that possibly he was making this presentation to General Somervell.

Q: In 1943-1944 operations, each objective and task force assigned to it were different. So task forces were structured for each case. Little in the way of standard operating procedures or standard tables of organization applied to this kind of operation. So task force engineers were appointed to do the best they could on the basis of their own experience to conduct combat and construction support. How did you go about selecting the task force engineers?

A: That was sort of primarily the Sixth Army function—the task force. It was under Sixth Army; it was appointed by Sixth Army. So Sam Sturgis, let's say, would have the primary responsibility of setting up the task force engineer complement, with our assistance. For example, even the organization of the corps engineer staff was so paltry that even they were inadequate either for corps task force or subordinate task force engineer operations. We were always in very close communication with Sixth Army, or later Eighth Army, with suggestions as to which officers could be made available.

But recognizing this problem, we sent in recommendations to the War Department for organization of an engineer construction brigade headquarters and headquarters companies patterned on and somewhat comparable to the engineer special brigade headquarters. It pointed primarily toward what we felt was needed in such a headquarters to organize appropriate task force engineer headquarters groups.

Q: With respect to the task force commanders, were there- any task force engineers who particularly distinguished themselves by their operations?

A: Well, I'm sure there were some, but by and large they all did well. Based on my memory as of now, I wouldn't want to pick out or indicate any special ones because I can't remember.

Q: Were there any that may have ruined their careers by inadequate performance?

A: Not that I know of. If they had, I think I would be cognizant of that.

Q: Colonel William Wanamaker was the task force engineer for Krueger's operations in the Admiralty Islands in March 1944. He apparently had all kinds of trouble due to poor organization and the lack of cooperation from the naval construction battalions?

A: At the higher echelons we had reasonably good relations with the naval Seabees. One problem that you had with the naval Seabees, they were made up of older men—very well-qualified personnel in the construction field, because they'd been taken largely from construction organizations in the States. They had very good equipment. They had higher ratings and so on in their organizations as compared to our Army engineer units. But they did sort of think on more permanent-type construction, rather than the military operational type such as we were involved with.

One thing, they felt that almost the first priority after a landing would be to provide a good living area for their command in the way of quarters, tent floors, water supply, and so on. And then, having gotten bedded down well, they would proceed with construction. Whereas with our Army construction units, our primary objective was, as soon as you land, you get in there and start working on the airdrome. At night or at other times, insofar as you could, you could putter around and take care of your living requirements.

That was one general difference in our thinking. And you have different commanders and different units. I think in Wanamaker's case you probably had more trouble with the specific Seabee commander, some of whom felt that they wanted to be under Navy command rather than operating under Army supervision and direction.

Q: The experience of Wanamaker in the Admiralties led you to get MacArthur to effect a reorganization that placed the naval construction battalions directly under the control of the task force engineer.

A: Well, I thought that was basically the situation throughout. Possibly in Wanamaker's case some of these Seabee units were under Navy control working solely on specific Navy operations. However, basically, throughout our operations, our task force commander and his task force engineer controlled all the engineer units attached to that task force, whether they were the Australian engineers, the RAAF work units, the Seabees, the aviation engineers, or whatever.

Q: For the Hollandia operation of April 1944, which was the largest to date for both assault and base construction, planning began well in advance and was planned by a team from Sixth Army and USASOS. Did this make the subsequent transfer to USASOS easier and did it make for better planning for the entire operation?

A: I'd say yes. After all, our procedure was that the task force would go in in charge of that specific operation. The task force commander had priority on the call forward of materials, equipment, and other elements in that command, though subject to the provisions of the operations instructions issued to him by our higher headquarters. Thus the task force engineer and his engineers operated under his command. That didn't mean that the task force commander, who knew nothing about engineering, would interfere and get involved in that; but it was still his mission, his authority.

The task forces were to initiate the construction of these dromes, bases, or whatnot immediately after landing. When the combat phase was over, if there had been one, it was our procedure to turn the responsibility for construction of these installations over to USASOS—frequently turning over most of the engineer units that had been operating under the task force to USASOS, and supplementing them with other units assigned to the USASOS base commander. Being able to plan and work together prior to the turnover, I think, effected better coordination and a smoother transfer of work. The work continued to go on without interruption. It effected a smooth transfer of responsibility.

Q: While your selection of landing areas was always very carefully made to avoid Japanese concentrations, weren't you a little surprised at the lack of effectiveness of the Japanese defenses and obstacles, use of mines, and their general engineer work?

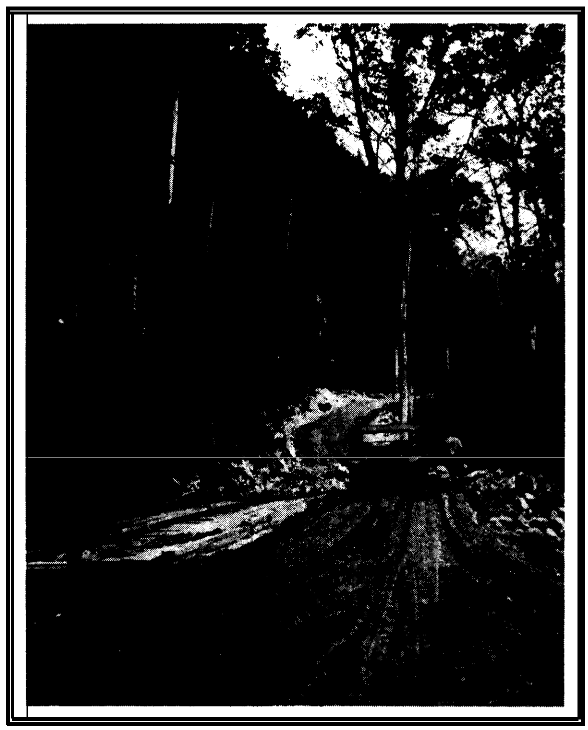
A: I was not surprised at the setup of the Japanese defenses. I think they concentrated on that, and I think they did very well in connection with local defenses–I mean, the utilization of bunkers and obstacles, booby traps, and hazards. I think they did that quite well.

The Japanese, of course, were handicapped by having nothing relatively in the way of heavy engineer equipment. They did not have the equipment, for instance, for oil pipelines and storage tanks for the movement, storage, and distribution of gasoline or fuel. They were relying on bringing the stuff in by drums of gasoline, trucking them to an airdrome, and then taking these empty drums back, putting them on a ship, and sending them back someplace to be refueled. And keep in mind that the empty gasoline drum is highly explosive.

The Japanese engineers were relatively heavily handicapped. I think they were far subordinate to the capacity of our American engineer units, which were well equipped and trained in the use of heavy equipment. The Japanese were using largely hand tools. It took 10 to up to 50 times, I guess, the amount of manpower to do what our equivalent units could do, and not nearly as well and certainly not as quickly. They were very deficient in engineer capacity, which I think they all recognized after the war.

Q: Their airfield construction was particularly poor, and airfields particularly poorly sited and drained. Can you explain that?

A: Well, as I say, I think it was, one, due to a deficiency in equipment, having to use hand tools and limited truck capacity and transport capacity; and they also were building their airdromes for a lighter type of aircraft. They were not operating with the B-17s, B-24s, and did not require the same length and width fields and the same strength of hardstand and runways as our Air Force required.



Cliffs around T jetty on a road from Bosneck to Nokmer on Biak Island, Dutch New Guinea, 5 July 1944.

Q: Do you remember anything that stands out in your mind about the Biak operation?

A: I'd have to refresh myself on that one. I know we ran into tactical difficulties which were ultimately surmounted; but as far as our engineer mission was concerned, it was very successful.

Q: When did it become apparent to you that an engineer headquarters higher than the task force engineer and regiments was going to be needed to control construction?

A: I think as we approached operations of the type and scope of Hollandia and Atape, rather than the prior, relatively smaller task force operations, I certainly visualized that some such organization would be needed with the invasion of the Philippines and certainly in the subsequent landing operations against Japan where our engineer forces would be massive in size. As I say, we recommended we get authority to set up these engineer construction brigade headquarters.

Q: How much did General Frink's establishment of a procurement and distribution division at Sydney and distribution branch with an engineering division at Milne Bay relieve your problems of procurement, supply, and distribution of engineer items?

A: Well, it was an approach. It wasn't the ultimate successful solution. It was an improvement over relying on going all the way back to USASOS headquarters in Australia. Setting up a forward branch with somewhat similar authorities and soon that they had at Headquarters USASOS brought closer to the area of need the facilities of such a command.

Q: That engineer troops had inadequate training for construction demands of the Southwest Pacific was obvious. Colonel Thomas Lane, who was your operations officer, ascribed this shortcoming to the emphasis after World War I on divisional or combat engineer operations during that war rather than on the less glamorous duties of engineers assigned to the Services of Supply in France. Therefore, the necessary logistical support experience was never taught or gained in engineering training. Do you think Lane's appraisal is correct?

A: I think generally so, yes. In World War I the divisions in combat were just stuck in solid trench warfare-not a war of movement and so on. And of course, they had the Service of Supply in the rear. But the operations of the latter were mainly building up depots, construction of depots, operation of railroads, forestry operations, and so on. But you had no such thing as task forces.

During a war of movement you had to build and maintain supply roads, provide utilities, in addition to the combat engineer phase. But in World War I they certainly had nothing like the airdrome systems we had to provide and maintain in World War II. Those senior commands and headquarters who were thinking in terms of what had happened during World War I were far out-of-date compared to what the needs and requirements and problems were going to be under the situation which obtained in World War II, and particularly in a jungle theater and unimproved and undeveloped theater such as we had in the Southwest Pacific. They just had not had the opportunity to experience or apparently even visualize what those requirements would be.

Army Service Command and Return to the Philippines

Q: What were your primary considerations for the establishment of the Army Service Command (ASCOM) in July 1944?

A: It wasn't my idea to set it up. But General Steve Chamberlain was our G-3 operations chief on our GHQ headquarters staff. And he was ideally qualified to be G-3 chief of operations because-not because he was a tactical specialist, but he had been a logistics specialist. I think he had been in our G-4 general staff in Washington. So he had an appreciation and a concept of logistic problems attendant with all of our operations.

He had a special understanding of the need for engineers and supported me particularly in connection with filling our engineer requirements.

Major General R. J. Marshall, Major General Spencer B. Akin, Brigadier General Marquat, Brigadier General Charles A. Willoughby, General Douglas A. MacArthur, Major General Steven J. Chamberlain, Brigadier General Hugh J. Casey, Brigadier General Hanford MacNider, Brigadier General Lester J. Whitlock, Brigadier General Bonner Frank Fellers.

He indicated to General MacArthur and to the chief of staff that he thought the critical problem associated with the projected invasion of the Philippines with major forces would be the logistics phase. He recommended that an Army service command be set up to be attached to Sixth Army with the special function of handling all the construction, logistics, transportation, supply, and so on. It was based on that that they organized such a command. He also unfortunately recommended that I be the commanding general. I would have much preferred to have remained as chief engineer.

Q: Did your appointment as commander of ASCOM pose any difficulties for you? Essentially, you were still the chief engineer of the Southwest Pacific.

A: Yes, but my deputy, Jack Sverdrup, then became acting chief.

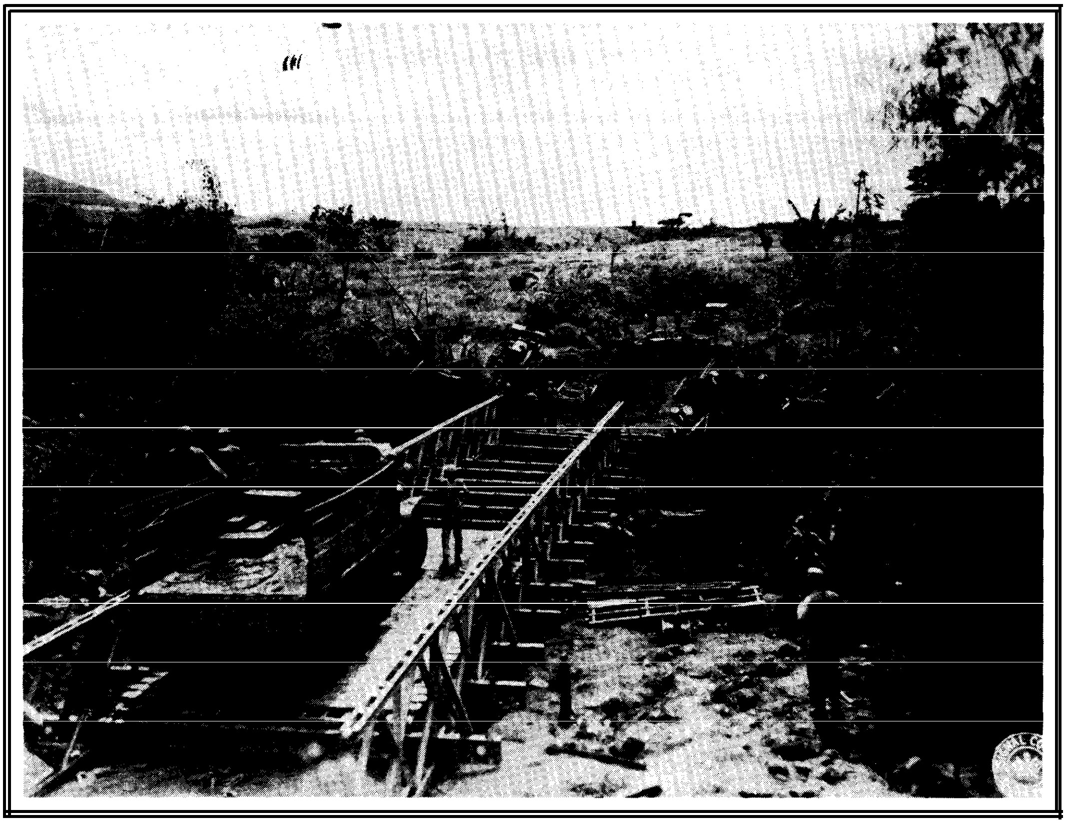
Q: He was acting chief. And yet you came under the USASOS and then Sixth Army, which nominally were under your technical direction for engineering purposes. Did that confuse the situation any?

A: No, no. It was understandable that ASCOM would operate under USASOS during the period of organization because it was necessary for me to get, in addition to our engineers, quartermaster corps, medical personnel, transportation personnel, signal personnel, and so on to handle the varied functions, the service functions of this new command. We worked with Frink readily and very well in setting up that organization prior to our transfer to Sixth Army when we were actually to join them prior to this advance, prior to these projected operations.

Leyte and Luzon Invasions

Q: For the major operations in Leyte, it appeared that you were going to have sufficient time, for possibly the first time in the theater, to develop plans for engineer operations and for base construction. Then the projected invasion date was jumped ahead two months to October. How much did this disrupt your planning?

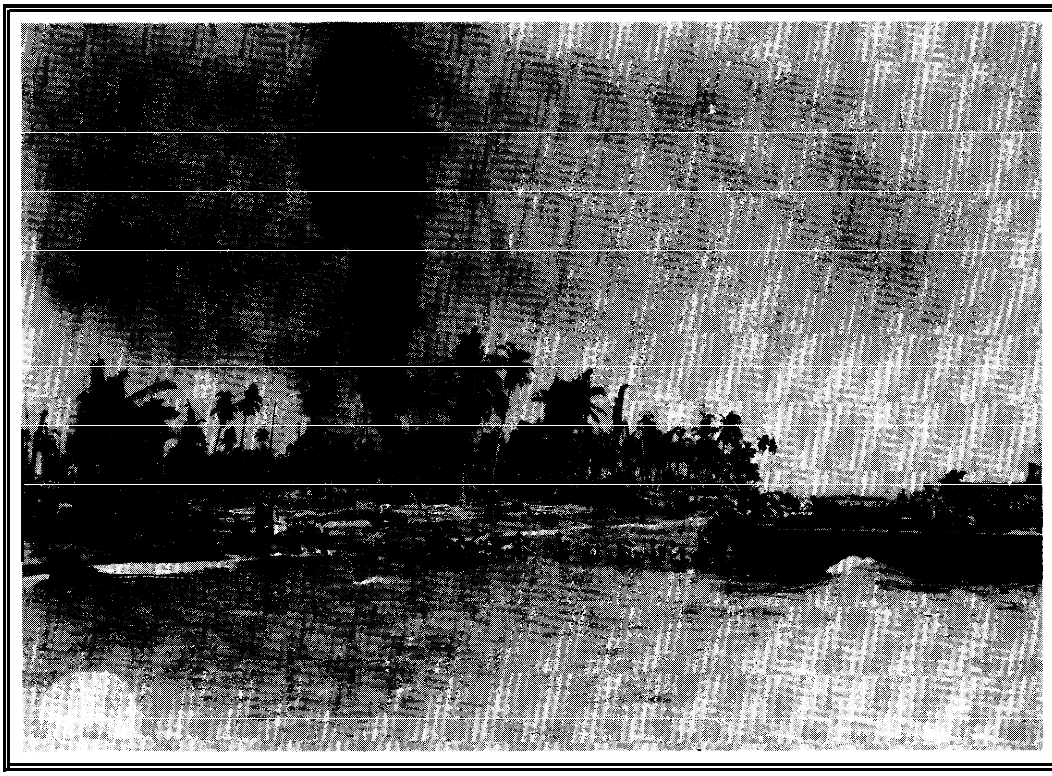
A: Untold problems. First of all, advancing up to then was putting us right into the middle of the rainy season with all the problems that that was going to bring about. The other thing–and this was a very vital deficiency-by reason of this foolish setup that the War Department had, we had to submit the overall supply project and get it approved. Based on that approval, you requisitioned backup supplies. They were finally approved; and then they were projected to come to us in time for this Leyte invasion, which was to occur later.



Construction of a Bailey bridge over the Sawaga River at Malaybalaya, Mindanao, by Company C, 106th Engineer Combat Battalion, 31st Infantry Division, 23 May 1945.

Well, when they advanced the operation, that meant that all these critical items of equipment, supplies, and whatnot were not going to be available under our prior carefully planned time schedule. We had also planned a landing preliminary to the Leyte operation in the Mindanao area. So when we went into Leyte, we had to use what equipment or supplies that had been approved for the much smaller Mindanao operation instead of utilizing the equipment, supplies, and troops that were projected for the Leyte operation.

Furthermore, for example, we diverted a Central Pacific corps that was on its way for another Central Pacific operation to ours. They had equipment and supplies tailored and shiploaded for their originally projected area. But it was a discombobulation, as for example the delayed shipment of ponton cubes for floating docks, the delayed arrival of steel landing mats for airdromes and roads. It meant a shortage of certain critical supplies and equipment that we needed because they were not to arrive until some months later for the originally projected date of those operations.



American soldiers pass supplies ashore from a landing craft, vehicle and personnel, at Leyte Island, 20 October 1944.

Another difficulty we had in the Leyte operation was that there was a much greater enemy force and greater enemy resistance than had been projected or anticipated. The Sixth Army had a much more difficult tactical operation. They were trying to take over the area against intensive enemy opposition. The combination of rain and its effect on supply roads and the tactical force demands meant that the number of engineer units that were coming in primarily to do certain ASCOM construction phases were not released by Sixth Army but kept by them in support of the tactical elements trying to keep these muddy roads open and supporting the tactical elements in a much more difficult type of situation than had been contemplated.

Aerial view of the attenuated ponton causeway spun out by the Navy's Seabees for water traffic in the invasion of Leyte Island.

Q: Leyte presented some different engineering problems to you. For the first time, you were going to have difficulties with extensive bridging support. How did you go about organizing yourself for that?

A: Actually, we didn't have in the Leyte operation any particular bridging situation. We did have, or would have, up in the Luzon operation in the advance on to Manila. But we didn't have, as I recall, any major bridging difficulties or problems on Leyte.

Q: By the time of the Leyte operation, how well developed was the coordination between the engineer special brigades and Admiral Barbey's 7th Amphibious Force?

A: I think it was excellent. I went upon the *Blue Ridge,* on Admiral Barbey's command ship, in the Leyte operation. We worked very, very well together. I think he appreciated that and respected the work of the engineer special brigades, both in the boat echelons and on the shore units.

Q: General Sturgis noted the GHQ allowed Fifth Air Force to select the airfield sites on Leyte rather than following what had been the routine procedure of allowing the task force engineer to select the sites with the air task force commander's concurrence. Why was this change adopted?

A: I don't think either of those is quite literally so. I think, based on map studies and available engineer intelligence, potential air sites were indicated; and those that were indicated were approved by the Air Force. As we got in there and found that conditions were different, particularly as affected by the torrential rain situation, changes were made not just by the task force commander, but by, let's say in this case, the ASCOM commander charged with that construction. But I didn't think that that was a special situation there. We did make changes in the location of the airdromes because some of them had been selected based on aerial reconnaissance and the terrain proved not up to the standards that we thought they would be—there were drainage problems and other problems.

Q: When you went ashore at Leyte on A-Day, did you go with MacArthur?

A: I unfortunately did not get ashore on A-Day. It so happened that on the *Blue Ridge* I sustained a very severe and painful sacroiliac problem, a cracked vertebra. All of a sudden I was in intense pain; I couldn't stand or walk. So the medicos took me and shot me with pain-killer and put me in my bunk. This was one landing that I could not possibly miss because I had left the Philippines 2 1/2 years earlier expecting to get back in 21/2 months. So they gave me an injection of dope and taped me up. Initially, they wanted to send me back to Hollandia for x-rays and treatment. I resisted firmly. So during the initial landing I lay in my bunk with a mirror through the porthole and watched the landing.

Then later on my chief of staff had gone ashore and found a set of quarters suitable for my temporary headquarters. He came back; they rolled me over, all taped up, onto a stretcher, lowered it onto a landing craft, and we made the landing. I was the only one that went in on a stretcher. They were taking them out on stretchers, but I went in like one of the old Chinese imperial warriors taken in a sedan chair.

Unfortunately, I was laid up for a week or more before I was able to get up and around. We had no hospital facilities there. However, the Seabees made me a corset from some canvas and some hammered-out damaged jeep springs and I wore that corset throughout the Leyte and subsequent Lingayen operation-not too comfortable, incidentally, under the high heat and humidity that prevailed.

In that connection, my chief of staff had selected this house, a rather large house. By the time they got me in the ambulance and came on up to this house there was a four-star sign over the arched entrance. I was wondering why I had gotten such rapid promotion. What had happened was that General MacArthur's aides had come by and seen this house and took it for his quarters. Well, by then there was nothing to do but to take me on in there.

So for several days I was in there in General MacArthur's headquarters. And he told Colonel Roger Egeberg, his medical aide, "Now you take care of Pat. Don't let them send him back to Hollandia and Australia, because we won't see him again." So Roger said if I were a cripple for life, I could blame it on General MacArthur because he charged Roger with taking care of me.

During that time and in those quarters, I was carrying on operations from there with my staff members. While there, my quarters were hit. You may have read about it in General MacArthur's book, where a shell went through the quarters and landed up on the roof rafters without exploding. Later a bomb landed just outside my window but fortunately just dug a big hole in the muddy earth, softened by the intense rain, and failed to explode. We had a busy time. I know that through the wall of my room, one of our own 20-millimeter anti-aircraft projectiles went through the wall, fortunately missing me. But it was an interesting time for General MacArthur and his headquarters and for me as a temporary residence until we found other quarters.

Q: Did you hear anything about the famous MacArthur debarkation from the landing ship and walk up the beach at Leyte?

A: No.

Q: There were many stories generated about that.

A: Yes, because, as I say, I wasn't there because of my injury. But I've seen pictures of it. Of course, it all happened.

Q: Is it true that they did rerun the scene until they got it correct?

A: I don't know. As I say, I wasn't there.

Q: From what you knew of him, do you think he would have done something like that?

A: It's possible. I don't think so. I know that it was his inner nature to want to be in the center of the picture and build up the MacArthur image. He was not one who was going to subordinate his actions or his personality if there was some opportunity to make it look more glamorous. He wouldn't forego that opportunity. However, I don't think he would go out and actually build up or make up such an artificial incident.

Q: That brings up another question. I think you were one of the few people who were there. Is there any truth to the famous "I shall return" statement?

A: Yes. That, of course, was down in Australia. He had a prepared message. He didn't say, "We shall return. " He stressed "I shall return." I think it was a very effective thing to do because it caught world attention, and I think it sort of helped bring us all together and say, 'You're damn right we will. "

Q: Sturgis, John Elliott, and Bill Ely quickly saw after looking at the airfields selected for Fifth Air Force that the soil conditions and drainage and road situation were really impossible. They then had a conference with ASCOM and Fifth Air Force on A +4 at which the recommendation was made to build alternative strips or to concentrate on Tacloban and Dulag. The Fifth Air Force refused and insisted that work continue on San Pablo and Buri. Were you at that conference?

A: No, but we continued on those others, but on a greatly reduced effort. We recognized that those fields were almost hopeless of construction in the time period in which they would be required.

I might say that on the Tacloban field, the Japanese had already built a short field there. But it was in the wrong direction for any extension. In order to get the proper length we had to make a major change in its direction, involving also a massive fill operation to extend it into the bay. For the first time in our operations, we had made previous arrangements to bring up a dredge. This was the first time we used a dredge to pump material and dump it on the projected extension. It involved a change in direction for the field and then putting in all this fill in order to get an airdrome of adequate length. It was a very special problem and, as I say, the first operation, I think, in which an engineer dredge was used for our operational airdrome construction.

Q: Why do you think the Fifth Air Force was so adamant about their airfield selections?

A: Well, they had approved them and they felt that those were the ones they wanted and damn it, let's go to it and get them.

Q: Apparently Colonel [later Brigadier General] David Heiman, who was responsible for some construction of the airfields, even took the extent of taking Generals Whitehead and Kenney out and showing them how bad it was, and yet that did no good either. So they were very stubborn.

A: They felt, "We want to go ahead and do it, " not appreciating or recognizing the fact, too, that a lot of the engineer effort planned for airdrome and other base development and which would have been on such construction was diverted by Sixth Army in support of the tactical elements because of the difficulties the combat troops were having in trying to make headway against the very strong Japanese offense and under terrible support conditions, where roads just became a mass of muck, requiring a massive diversion of engineer effort just to maintain the support roads for the advancing troops.

When we had this problem of airdrome construction and the fact that certain of the sites were almost impossible, we did come up with a proposal that we move Sixth Army Headquarters, which had set up its headquarters along a beach area where there was a good foundation for drainage and so on, except that one end of it faced this steep hill. But the need was so great, we finally got Sixth Army to move out, relocate their headquarters, and then we developed that airfield and developed it quickly. It was a good operating airfield except that it was restricted to a one-way approach. At the end of the runway on the land side there was a steep high hill so that planes had to come in in one direction and take off in the opposite direction, rather than be able to fly from both ends of the field.

But it served its purpose and did call for the cooperation of General Krueger and his headquarters to vacate their headquarters and set up new signal installations and so on. But it made possible an early development of an additional airdrome that worked effectively.

Q: That airfield, for my note here, was Cabanatuan and was built by Colonel Harrison. I have a hard time with those Philippine names. Tacloban came under heavy enemy air attack on A +5 as the Japanese Navy moved during the Battle of Leyte Gulf. Despite these attacks, despite the landing of Navy fliers from the escort carriers that were being sunk by the Japanese, your engineers kept working on the field. Were you at or near Tacloban during that period?

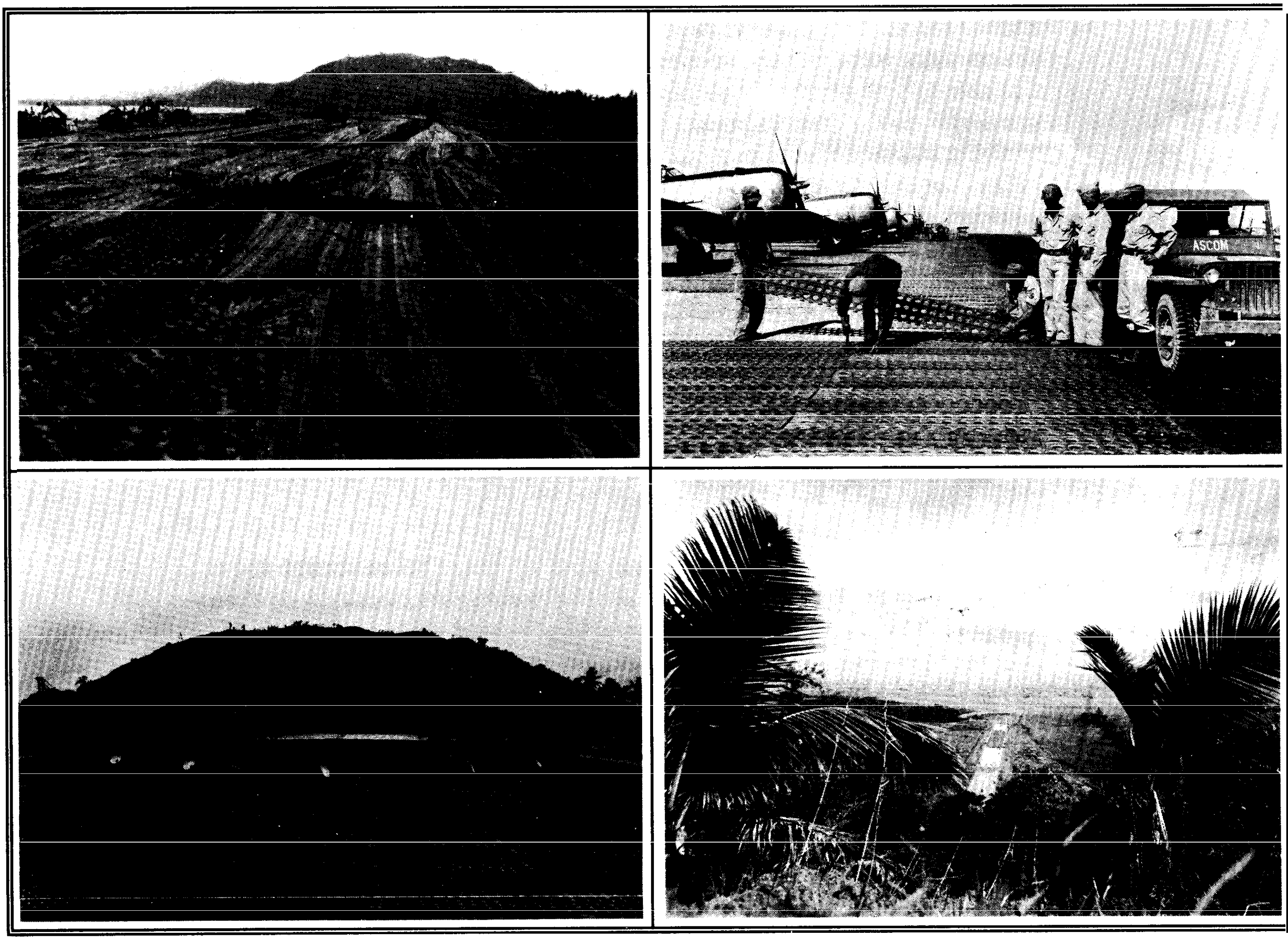
A: Yes. What had happened there, Admiral Halsey, whom I respect very well, was always eager for a fight with the Japanese. He had that characteristic more than I sensed other Navy heads had. But his primary mission was to protect the landings at Tacloban and on Leyte. But he got word that there was a Japanese task force way off to the northeast somewhere. He took his force, headed for it, and left. He was really giving up his primary mission of protection.

Well, in the meantime, there were three Japanese naval forces approaching Tacloban: one coming up through the straits there by Mindanao; another one coming down from the north; another one coming through one of the interior straits. Fortunately, Admiral Kinkaid, with his old battleships, met this southern force as they were coming through this narrow channel and he was able to sink practically all of them [Battle of Suragao Strait]. He did a wonderful job. The Japanese force coming down south started their bombing and so on, attacking our few small escort carriers. Now if he had kept it coming for another 20 minutes, I think he could have sunk every transport that was in the bay and just would have destroyed the Leyte operation. But we sent instructions to the Navy fliers, who had taken off from their escort carriers-they had no place to land when they were sunk—we sent radio instructions to them to land on the Tacloban strip. But the Tacloban strip was not completed and in a partial stage of construction, but the Japanese apparently felt that here we had an airstrip for land-based aircraft. Considering that, or for some reason or other, they turned around and went back north. If they had kept on coming for only 20 minutes or so more, they would have destroyed our whole invasion force and our entire Leyte operation.

In the meantime, Admiral Halsey got word of this. So he turned about, rushed down as fast as he could, and he was able to hit this northern Japanese force on their withdrawal and effect major casualties. We were very fortunate that the Leyte operation was not a disaster due to Halsey's failure to comply with his primary mission instead of going off shooting swallows.

Q: So you must have had some pretty anxious moments, A+5 and A+6, when you weren't too sure what was happening. Did you have a grasp of what was going on in those battles?

A: We had hopes. Our combat troops were having problems. The Japanese were sending down reinforcements to their land forces. As I said, we had this problem of the naval, Japanese naval attacks in which, fortunately, in the way it ended up, we had taken care of the Japanese Navy quite well. From then on it was just a matter of carrying through on strong enemy ground operations and, with great difficulties, carrying on our construction program.



This series of pictures shows the development of the critically needed Tanuan airdrome of Leyte.

***Top left:** Looking south. Strip site clearing and rough grading in progress. Note the hill squarely across the south approach.*

***Top right**: Looking southwest. Men of the 1897th Engineer Aviation Battalion lay steel mat over base. Major General Hugh J. Casey, standing center, watches.*

***Bottom left:** Looking south. Completion of the steel mat over base. In spite of the hill, the strip was used for two-way operation for fighters.*

***Bottom right:** Looking northeast. Strip was in operation 16 December 1944.*

Q: Even before Leyte was secured you began work on the Luzon operation. How much did your familiarity with Luzon help you in your planning?

A: The fact that I knew the Philippines, and more particularly Luzon, I think was very helpful, knowing what the situation was at Lingayen Gulf and the Agno River, in the Central Plains, and also, as I say, having had a personal relationship with the Philippine forces and the Philippine civil works group.

I think all of that was helpful. One other thing, too, that we had in connection with the Luzon operation was the experience of the Leyte operation. I had gotten Colonel Herbert D. Vogel as the projected base commander for the base that we were going to establish up at Lingayen. I had him and some members of his staff working with General Wallender on Base K, observing the setup, the problems, and this and that. I think that was most helpful in preparing him for his projected assignment. Incidentally, Vogel did a very fine job on the Lingayen operation.

Q: In the Lingayen Gulf operation the selection of landing sites was extremely critical. You did a lot of study and very careful selection of the sites.

A: Well, I don't think that the selection of landing sites at Lingayen was a super-critical problem compared, for instance, to what it was down at Leyte. At Leyte we had, as usual, made our engineer intelligence studies beforehand. Our office turned out this study before the operation indicating that on Red Beach we were going to have difficult landing conditions; that we would not be able to get landing craft less than, I don't know, maybe 600, 700, 800 feet or more from the shore. In case of enemy opposition, it was going to be difficult traversing that distance from where your landing craft would be grounded. We had to assemble ponton cube ramps and so on. But up at Lingayen our studies indicated that we had a relatively smooth beach over a great expanse. I didn't remember any special problems in selecting the landing site.

Q: The problems were in the selection of the beach in respect to the area behind the beach that would restrict egress from the beach area.

A: No. Up there it was relatively open behind and over a broad area. The Japanese had made their landing there, and we made our landing at virtually the same spot.

Q: For the drive down the Central Plains toward Manila, as you mentioned previously, one of the major problems was going to be bridging.

A: One of the major problems was going to be bridges. There was very little Japanese opposition at our landing. The Japanese had withdrawn gradually, planning to make a stand at Manila. Other major enemy elements had moved up to the mountain areas around Baguio and up to the northeast. There was a threat that if we made a landing and proceeded due south they could come down from the mountain area, cut off our base and supply lines, and do a lot of damage, so that the Japanese force in the northeast created a serious tactical problem.

But going on south there was the matter of crossing streams and rivers, and with this large force moving south, there was a big requirement for bridges. In anticipation of that, we had requisitioned large quantities of Bailey bridges. Most of that bridge construction was done by the combat engineers with their divisions and under Sixth Army Headquarters direct, as they were the direct support of the advancing combat divisions. ASCOM's problem was on the development of the bases, airdromes, oil pipelines, and similar support facilities.

We did have a number of bridging problems. Some of the major bridges which we had destroyed several years earlier in the early phase of the war in opposing the original Japanese advance from Lingayen to Manila still remained destroyed. But another problem we had in connection with the repair of bridges was that our over-ambitious Air Force, in their bombing on ahead of our advancing forces, chose a lot of the bridges which we needed to cross on the way down. So one of the problems we had was that here was a beautiful bridge, but the Air Force had come along just ahead of us and destroyed it. Within hours the poor engineers had to go about rebuilding it.

Q: You wanted to mention something about General Sturgis in connection with the Lingayen operation?

A: Sam was a classmate of mine whom I knew very well. We worked together extremely well. Sam did exceedingly well on that operation, as he did on anything which he was involved in. Anything with which Sam was involved was the most important phase of the whole war effort. His mission was primary. It was more important than what anybody else was doing or had to do. He would fight for the maximum amount of engineer support or equipment or priorities, priorities of transportation. He was so persistent in it that he was successful. Sam was able to get, I think, support for Sixth Army to a greater degree than what possibly almost anybody else in a similar capacity could do. We had a good relationship with his engineer units and commanders; and his engineer section functioned as a very smooth-running machine.

Q: Due to the problems that had been encountered with the airfields on Leyte, Kenney requested special consideration for airfield construction in the Lingayen operation, even to the fact of calling a conference that included himself, you, General Krueger, and Sturgis to discuss the preparations for the airfield.

A: The ones who were primarily concerned with early airfield construction were not necessarily Kenney, but the Navy itself. The Navy had brought in their aircraft earners to lend air support to the operation. An unfortunate situation, however, with respect to Navy Air is they do not want to risk loss of their aircraft carriers from enemy air action. The Navy had given notice that they would remain up there giving air support, I think, maybe for five or six days only, at which time land-based aircraft had to take over.

So that was Kenney's concern. We knew we had to have an airfield ready, let's say, in six days. That was when we decided that we were going to build our airstrip right on the beach area, right in Lingayen. The soil conditions were excellent. We had insisted that we had to get first priority in ship loading and unloading for steel landing mat because this was to be a steel landing mat field. That was an important phase, because usually with a task force they're concerned with getting ammunition, getting their rations, getting certain things like that unloaded first. They're not so much concerned with the things that go into engineer construction.

At that conference with General MacArthur and others, we stressed that the first priority in unloading had to be given to special ships carrying the landing mat that we were going to utilize on this airstrip. I might add that we did build that airstrip, and on schedule. You talked about dust. I remember we used brush and so on under the landing mat to control dust. In any case, under intensive effort we did have the field ready. I don't know whether it was in five days or six days after the landing. But we had it in time, so our land aircraft were operating from there in time to relieve the Navy aircraft carriers on their projected schedule.

In that connection, we had projected another airdrome in that general vicinity which involved removal of a lot of heavy timber, trees and whatnot. It was going to be a rather delayed task. I had set up my headquarters in a small schoolhouse in a place called Mangalden, and adjacent to it was a very large flat rice paddy area. During the rainy season this whole area would just be a mass of mud and small dikes where they were raising their rice crop. But this was the dry season, and I decided to check to see what the possibilities were for an airfield. So I got some heavy equipment and moved it over various parts of the field. We found it did not sink into the ground. So we went ahead and bulldozed down all the small dikes that embraced this vast area of rice paddy and leveled it. In very short time we had prepared a landing field about 2,000 or 3,000 feet wide and 6,000 feet or more long. It was just a beautiful area for an airdrome.

To our great delight, it was stable enough so that the Marine Corps aircraft could use that as an airdrome. We'd have three or four or five or six planes take off simultaneously, and it worked effectively for the duration of the time that we needed it. If you tried to look for that maybe later during the rainy season, you wouldn't have found it for several months.

I might add an incident that happened there. One morning, as a flight of three light bombers took off, the bomb on the near plane came loose and whizzed along on the ground only a short distance from my office where I was at my desk. Fortunately, not having been dropped in flight long enough to be set for detonation on impact, it failed to explode. I then grabbed my phone, called up Colonel Jerome, the Marine air commander, and said, "Colonel, will you please add some stronger mucilage to your bomb attachments as you've just dropped a bomb here that just missed my IN basket, which is full already. Thank you. " In no time flat he hopped onto his jeep and rushed over to apologize. We became good friends from then on.

Q: At Lingayen, from what I read of General Sturgis's work, you had supplies that were shipped directly from the United States to Lingayen, and you had a lot of difficulty with some of the materials you received directly from the United States, specifically pipeline supplies.

A: Yes. You wouldn't always get a tailor-made integrated shipment. You might have the fittings for the pipeline and iron for the tanks on one ship and the pipe on another. You frequently had a lot of miscellaneous equipment that was put aboard a ship, but some critical parts that were supplement to it were in some other ship someplace else. You must recognize, however, that in time of war you will not have a relatively smooth operation with everything precise. That means that you have to be prepared to accept difficulties, problems, and still work around them.

Q: In general, did the Japanese defenses in the Central Plains cause any great problems in your drive to Manila, or was it primarily the fact that they blew some bridges and they hadn' t repaired the others?

A: There was no particular problem in connection with any Japanese defenses—defenses that they made prior to our advance south. There was the matter of obstacles in crossing the streams and so on where bridges had to be constructed-that is, until we got down to the strongly defended Manila area.

Q: On 13 February 1945, ASCOM was transferred to USASOS and became the Luzon Base Section, while you returned to be chief engineer of Southwest Pacific. Could you evaluate ASCOM's performance? Did it achieve generally what it had hoped for?

A: I would say generally so. As I say, ASCOM had problems at Leyte by reason of the abrupt change in plans advancing the projected invasion date by over two months, and also by the extreme rain conditions and the fact that our combat troops were held up, both by weather and intense enemy opposition, such that there was a great diversion of engineer effort that was supposed to go into base construction for combat support.

Up at Lingayen, where the weather conditions were more favorable, I think everything went along extremely smoothly. We were able to get in readily, build the supporting airdromes, build the supporting base, setup supplies, arrange for forward movement of supplies and so on, in support of the advance of the Sixth Army; also in support of the Sixth Army elements that were operating against the large enemy forces in the northeast toward the Baguio area and also the local units that were requiring direct ASCOM or base support. In our transition we already had Base M [Manila] all set and organized. So it was turned over to Vogel and USASOS, and the turnover and subsequent operation went along quite smoothly.

Q: Do you have any explanation at all for what was apparently the very amateurish use of mines by the Japanese? They didn't really present any problems at all in delaying your advance.

A: No major problems. It could have been due to shortage of them for the rather extensive area involved or because they were moving out in such haste. I do know, however, that in a carefully prepared defensive position, such as in the jungles, where they had time to prepare, they did a very good job in connection with obstacles and booby-traps and things like that, as well as in location of their machine guns and utilizing cover.

Q: Did you accompany MacArthur on his return to Manila?

A: No, I actually got into Manila well ahead of him. I wanted to see what the problems were with our tactical forces as well as to ensure that our ASCOM logistic support to them was functioning. First I went up to observe the tactical forces operating in the mountainous northeast area. General Krueger found me there and he was quite stem wondering "what in the hell" I was doing up there. He told me I was supposed to be back nearer my headquarters. He had arrived there with a platoon of troops as his protective guard, which routinely accompanied him. Of course, all I had was my own small jeep and driver.

Later, as we were advancing on down to Manila, I drove down and joined the 1st Cav [1st Cavalry Division] in its advance down Dewey Boulevard. I arrived while we were retaking the Army-Navy Club and entered it right after we had taken it. The number of Japanese dead was an index of their strong defense. Then we had the problem of capturing the Manila Hotel and the intervening area against continued strong enemy resistance. So in answer to your question, I was down there before rather than with MacArthur.

Major General Hugh J. Casey discusses the rebuilding of Manila City Hall with Sergeant Hugh D. Mason, 1879th Aviation Battalion, 23 March 1945.

Q: Was General MacArthur disappointed at what had happened to his former headquarters? Apparently he had lost a great deal when he got back.

A: I don't think he was overly concerned about that. That was just one relatively minor element. His former headquarters were comparatively small. This small structure was built on the old stone wall there at 1 Cane Victoria. It was a very modest setup. And the loss of that and its contents was relatively nothing.

I think, however, that he and all of us were disturbed at the tremendous amount of destruction in Manila, not just the demolitions that the Japanese had performed but also what later happened from the destruction our own troops did. We brought up tanks and artillery, blasting into the public buildings, the Manila public buildings where the Japanese had holed up and were making their final stand. We had to go in and blast them out. Loss of structures is less than the loss of lives.

Q: Could you tell the story of your personal papers from the time you were engineer of the Army Forces Far East in 1942 and you had them buried?

A: I didn't have them buried prior to my departure. When we left, I left them and all other files at our engineer headquarters there. But when it came time for the surrender, the staff that we had left took our principal papers and records that we had in the Engineer Section, and they took them out and concealed them in a garbage can and put them in a small cave on one of the roads.

Later on, when we got to Manila, we freed the prisoners who had been there. I found notes from Major Kircher, who had been one of my assistants, and also from Major Bill Gay, both very outstanding officers who were killed when the ships taking them and other prisoners from Manila to Japan were bombed, unfortunately by our own American aircraft. But they had left pencil notes for me, which I still have, relating where they had hidden certain records. So I sent a small task force out and we were able to recover them. They were the ones that secured them.

Q: The clearing of Luzon and the rest of the Philippine Islands took some months. But most of the significant engineering problems were in the rehabilitation of the islands and the development of a base for the coming attack against Japan.

A: As I say, Manila was a wreck. The water supply had been destroyed. The water lines were all shattered. When, for instance, during the reconstruction we repaired one section of the water distribution system and built up pressure, that in turn could create more breaks in some other parts. It was a long, arduous task to rebuild all of the utilities.

There was also the problem of clearing out all the debris, even before rehabilitating or constructing headquarters buildings and depots. There was a problem with revamping Clark Field in central Luzon, and also the other airdromes around Manila and elsewhere.

Engineer Organization in the Southwest Pacific Area

One interesting thing, as I said before, I had built the Caliraya Hydroelectric Project in my 1937-40 tour as engineer adviser to the Commonwealth government. And shortly after war broke out—at that time I was chief engineer, GHQ—I was the one that had to destroy it prior to the Japanese advance on Manila. Now that didn't mean destroy it, but to disable it from operation, because we were sure, at that time, that we'd just be out of there for a matter of months and then, with reinforcements coming, we'd be able to take everything back over. So we didn't want it destroyed, but we did want it disabled from use by the Japanese.

So we had them empty the reservoir, open up all the gates, and also take out critical parts from the turbines and generators. It took the Japanese a long time to restore it to operation. Just prior to our advance to Manila, the Japanese decided they, too, were going to destroy it; and they weren't going to just disable it temporarily. They did a real job of destruction, blowing up turbines, generators, part of the huge penstock.

But anyway, I assembled the old National Power group, found out where they had hidden some of the critical parts and got parts from one unit to repair the others. We put in special orders to the States for other parts to get the turbines or generators back into operation; shortly after, we got all of them back in operation.

I thought the sequence of it all was interesting. I had designed it, built it, and then had it disabled. The Japanese came up and rebuilt it and later destroyed it. Then it was my role to reconstruct it. So it was up and down, up and down again, and finally up.

It was quite important to get hydropower. We had the large MERALCO fuel power plant after its reconstruction and a number of small diesel electric plants, but they added to fuel problems. We also got the Bureau of Public Works people, got them together, restoring and operating the various utilities. Even more important, we recruited large numbers of Filipino civilians and organized them into sort of semimilitary work units, somewhat like the CCC here. We had them organized into companies and battalions. And we used those, many of them, on the reconstruction projects that we had.

US Army Forces, Pacific, and Planning for the Invasion of Japan

Q: Did the establishment of the US Army Forces in the Pacific (AFPAC) under MacArthur on 6 April 1945 mean any really significant change in your duties at that time?

A: Well, with that we took over the Central Pacific area and command and they all came under our control. That meant that Okinawa, which had been under the Central Pacific, was now under our jurisdiction. So in addition to the Philippines and the areas that we had before, we expanded our operations to take in Okinawa, where fighting was still under way, and ultimately Japan.

Knowing the importance of Okinawa, particularly in connection with its use as a base for projected operations against Japan, I sensed its major importance. So even without instructions I promptly flew up to Okinawa. General [George J.] Nold was the engineer under General [Simon B.] Buckner, commanding general of Tenth Army, who was later killed-in fact, he was killed shortly after I was up there. He was killed on the very same spot where I had gone to do certain observations on our operations against Naha.

I noted the problems they were having in connection with their airdromes development program. I sensed that they needed additional engineer support. So on my return to Manila, I ordered either five or six engineer battalions (construction battalions or aviation engineer battalions) up to Okinawa under Nold to reinforce their engineer strength, even though we had problems, though of less strategic importance, down in the Philippines. I felt the need then for work up there was of far greater importance than reconstruction in Luzon.

Army and Navy Leaders in the War in the Pacific

Q: What was Simon Bolivar Buckner like?

A: I didn't have much opportunity to know him. I knew him during the few days that I was up there on my inspection tour when I was working with Nold. He seemed to be a very likable as well as able person. I thought he had the situation well in hand, with a fine headquarters and staff. Also, I don't recall who was in command of the large force of Seabees-a senior Seabee officer-but I had a good relationship with him, too. They were all functioning well as a team on this joint effort.

Q: What about George Nold, who had been engineer up in the Alaska Department before going to the Pacific?

A: I'd kown George since our relationship on the Engineer Rifle Team. He was a member of the team, and he and I had been shooting partners. Also, he served on the team again when I was coach of the team. So I'd known him very well. I don't know about his operations or activities up in Alaska. I knew that he had served up there. But he had taken hold and was doing very well with—was it the Tenth Army?

Q: Tenth Army.

A: The Tenth Army, yes. He was doing a very good job.

Q: Did you have anything to do with General Frink's establishment of engineer districts to assume construction responsibilities in the Philippines in February 1945?

A: I don't think that General Frink was the one that had to do with the establishment of the engineer districts. Jack Sverdrup, my deputy, and I were talking about it, appreciating that reconstruction of the Philippines and some of the other work there was not, you might say, an active military operation under combat conditions. We felt that, knowing what we had to do for the invasion of Japan (for Kyushu and for Honshu), calling for large forces for Okinawa, it would be desirable to organize an engineer division and districts for the Philippines to release all of our engineer troop units for the forward operations.

I think we prepared a study and presented it. I don't know whether it went through Frink or directly through MacArthur, with Frink's coordination and cooperation. We recommended the setup that was to be the Western Ocean Division, with division headquarters on the West Coast, setting up a district in Manila, in Guam, and also ultimately in Okinawa as and when the tactical situation there was resolved.

Q: Sverdrup pushed the idea for a single construction command in the Southwest Pacific and finally got the establishment of 6 March 1945 of the

Engineer Construction Command (ENCOM) that was set up under him, assigned to USASOS to coordinate and supervise all construction in the Southwest Pacific. How did that function?

A: It wasn't to supervise all construction in the Southwest Pacific. It was primarily to undertake all the construction there on Luzon. That was a major construction job. So we set up this Engineer Construction Command so that all of our engineer units would be under a central engineer headquarters.

Q: Did it work as you planned it?

A: Yes, it worked well.

Q: Simplified the construction and the management of construction?

A: Yes.

Q: Colonel Thomas Lane, who was then Sverdrup's operational chief, suggested a separate district be set up to rehabilitate Manila. Now MacArthur asked Reybold to supply the personnel for this, which he did; and he established the General Engineer District at Manila. Did it do its job well?

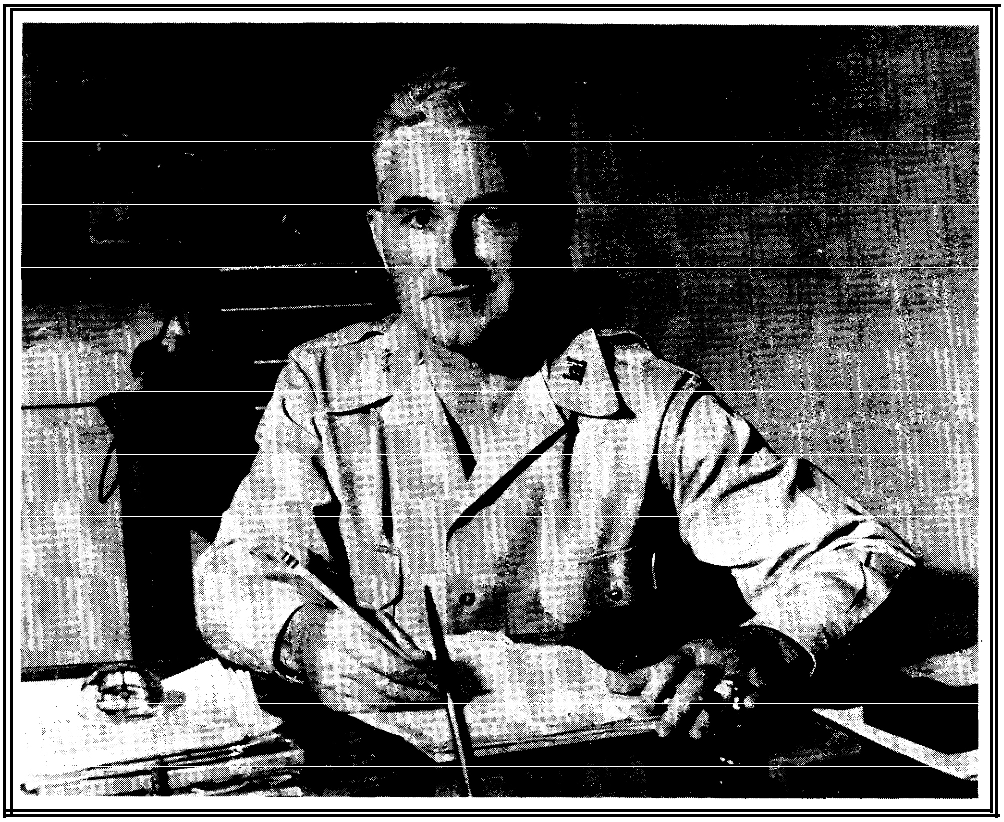
A: I think I was ahead of myself when I talked about the organization of the Western Ocean Division. I think the first phase was this establishment of GENED, this General Engineer District, to take care of the peacetime reconstruction in Manila. It worked effectively. As I say, it was a prelude to later on the setting up of the Western Ocean Division with separate engineer districts in Manila, Okinawa, and Guam.

General Comments

Q: Was ENCOM what the engineers had wanted since Australia? Was it what you wanted to have as your construction agency all throughout the war?

Was it the ultimate development, or were there still other problems that it didn't solve?

A: Well, the way we had been functioning, with moving task forces and the principal engineer operations here and here and here–it wasn't as though the engineer construction was all in an area such as the Philippines or Luzon or all in an area such as Australia. But with the flexibility and diversity of action, I think the setup that we had with task forces and so on was preferable.



Major General Hugh J. Casey, Office of the Chief of Engineers, at his desk in the city hall building, Manila, Luzon, 21 July 1945.

Q: In June, USASOS became Army Forces Western Pacific under Lieutenant General Wilhelm D. Styer, and it had its functions expanded to control all logistic support for Army troops in the Southwest Pacific. Did it present any problems for you?

A: No, it didn't present, I would say, any particular problems. I didn't see either where it presented any special advantages. They were not going to have any control over our operations up in Japan, the invasion there. At that time we were looking forward to completion of Okinawa and our projected operations in Japan. We now would have a headquarters that was going to take care of, you might say, all of the other miscellaneous problems down in the rear, and that was okay.

Q: Did the B-29 bases on Okinawa present any severe engineering problems?

A: Not particularly, other than its extent. On Okinawa the terrain was relatively well suited to airdrome development. We had lots of coral and so on and various suitable sites, so we had no insuperable difficulties. Also, you might say we owned, or rather controlled, the land, so we didn't have to get permission from the landowner for rights of way or for acquisition of terrain, such as we had in peacetime when we were trying to develop airdromes in the Philippines just prior to the war. We had carte blanche to go and do whatever was necessary. Airdromes, roads, base development, POL [petroleum-oil-lubricants] installations were all given very high priority, so we had fine support. We had a concentration of effort there instead of the diversion on many, many other operations at the same time.

Q: What were the differences between building an air base for a B-29 to use versus an airfield for a B-17?

A: So far as we were concerned, there were no major differences outside of increased length of runway and width of runway, taxiways, and hardstands. Some airdrome site might be marginal for B-29s but still potential for B-17s. You had to concern yourself a bit more for a B-29 operation and give greater attention and concentration to the base preparation and the materials that you had, not only for the runway but also the taxiways and hardstands, where they were going to be located in dispersed areas off the field.

Q: Could you discuss the engineer planning for Operation OLYMPIC, which was to be the invasion of Kyushu?

A: We were engaged in that for quite some time. It was a major planning operation. It was going to involve—I don't recall now the number of troops-maybe a force 600,000 to 700,000 with about 200,000 to 250,000 engineers.

For the subsequent operation on Honshu [CORONET], I think we were planning on a force of maybe a million or more men. I think our engineer force was going to approach 300,000 or more. That meant that our engineer mission was big, important; our logistic requirements were going to be very high—steel landing mat, oil tanks, oil pipeline, asphalt, lumber, whatever would be needed for water supply improvement, for shelter, for depots, extra special equipment, and pile drivers. So we had a major task. So we set up bills of materials, supplemental equipment, and supplies that we would need and the priority in which we wanted those delivered before and during the operation. It also involved review of our troop list, the units that we had, and maybe if there were some specialized requirements, what special units and modifications we'd need. We'd be needing dredges and such outside of what normal engineer requirements might be.

Q: One of the most severe problems you had in planning for both OLYMPIC and CORONET was a very bad lack of information on Japan.

A: Well, I don't know that it was terribly deficient when compared to lack of information on other areas. We were conducting aerial reconnaissance missions. At that time our Air Force had attained superiority in the air; our Navy had attained superiority on the sea. So we were able to get reconnaissance photograph y. As far as detailed dispositions of the Japanese forces and so on were concerned, we didn't know as much as we might have. But our intelligence agencies had tried to assemble every bit of information they could.

We got a reasonable insight, I think. We knew that much of Japan had been largely destroyed. We knew that its railroads and its roads, its industrial establishments, its principal areas around Tokyo and Yokohama had been badly devastated. So we knew we were going to have a lot of problems in connection with reconstruction as we advanced regarding the facilities, airdromes and so on, that we'd require. Their airdromes were not capable of handling our B-29 or heavy American aircraft, so we'd have major problems that we anticipated in that phase as well as others.

Q: Did you have any long discussions or any discussions at all with General MacArthur during the planning phase for OLYMPIC or CORONET?

A: Well, on and off at staff conferences where we discussed various phases of it. But he didn't call me aside and spend hours just on the engineer phase, if that's what you mean. It was just in connection with our general discussion with G-3, G-4, signal, special staff sections, with the Air Force and Navy and whatnot—you know, general staff conferences such as we had. He did not, for instance, have any special conference at all with me insofar as just the engineer phase was specifically involved.

Q: Was General MacArthur very worried about the potential loss of life involved in the invasions?

A: Well, he was naturally concerned. But I think we all felt that the great superiority of our Air Force, with the support of the Navy, with the equipment that we had and the trained manpower-we were now the first priority theater, so we'd have no major problems with procurement-we could get, we thought, what we wanted. And through aerial photography we saw the extent to which Japan had been damaged. There was sort of a feeling that Japan was about to throw in the sponge. In fact, we prepared an alternative contingency plan covering that possibility [Blacklist. If they had held out, the way the Japanese do, fighting to the last man, our casualties could have been high.

But I think he sensed more the fact that Japan had been greatly destroyed and damaged, rather than being concerned with their great capacity to destroy us and make the invasion difficult. My reply pertained to the situation prior to the dropping of the atomic bombs.

Q: Was there any consideration given at all by any member of the AFPAC staff to the idea of letting the Air Force bomb Japan into submission and the Navy strangle it, rather than invading?

A: Well, you might say that the Air Force had carte blanche in connection with the air bombing, because they were doing that continuously. But it was not expected that we'd stop everything else and just count on the Air Force going in and hitting them and hitting them until they finally said, "We surrender, " because we did not expect or anticipate that that alone could have accomplished it.

Q: As the war in the Southwest Pacific had progressed, your organization had changed to meet the changing conditions. Did you find that the final organizational structure you ended up with solved the major problems you had faced?

A: I think basically, yes. You're talking now of the organization. At that time, General MacArthur's headquarters commanded the entire Pacific, including the Central Pacific Theater. It was organized in connection with the planned operations right into Japan, so it was a major headquarters organization. But I think it was well organized and adapted to that proposed program.

Q: Was the key to your success in engineer operations in the Southwest Pacific the ability to adapt your organization?

A: I think it was a major factor, certainly. I don't think you can carry on war by the book. I think there was too much of a tendency in connection with people, let's say, who had gone to Leavenworth and they had map problems and so on, to seek set solutions based on set circumstances. But with the type of warfare that we had, you had to adjust your thinking, your thoughts, based on whatever the immediate problem was, what the difficulties were in terrain, what the problems were in getting materiel, in getting equipment, getting supplies. So you had to have a great degree of flexibility in mind and thought and action.

Q: Do you think that the failures and shortcomings of the Japanese engineers were as important to the defeat of Japan as the American engineers were to our victory?

A: It certainly was a major factor. Let's take the Hollandia operation. We went in there after they had occupied that area for some time. They'd tried to develop airdromes. They'd tried to develop roads to it. They'd made very little progress compared to what the total need was. They had no fuel pipelines or storage tanks, having to rely on the handling of oil drums. It's just basically due to the fact that they were not set up and organized and equipped with heavy construction equipment, such as our American engineer units were. You saw the effect of that, I think, on most of the major operations.

Q: Did you ever get a chance to talk to any of the engineers of the Japanese armed forces, either after they were captured or after the war?

A: No, not particular y.

Q: I want to ask you for your personal viewpoint and observations of some of the men you worked with during the war. Walter Krueger?

A: Krueger was a very fine and able commanding general. He was not the so-called "Lightning Joe" [J. Lawton Collins] type, such as General Eichelberger, who more nearly represented that type rather than the Krueger type. Krueger was a solid, substantial commander. I think he commanded the respect of his staff and all those under him. But I wouldn't sense him as one who could make quick changes in plans or adapt himself to a quickly changing solution. But he was a good, hard, solid sledgehammer type of commander.

Q: What about George Decker?

A: Decker was his chief of staff. Again, a solid type. I didn't gauge him as one of quick brilliance and adaptability to quick changes. But he also was a good, solid planning type and one who carried out the directives of General Krueger very well, coordinated staff activities, and did a very fine and outstanding job as his chief of staff.

Q: Would you have ever envisioned him as a future Army Chief of Staff?

A: I would not personally, as of then.

Q: What about Robert Eichelberger?

A: Eichelberger was, as I say, referred to as the "Lightning Joe" type. He was more of that type than Krueger. In the later phases of the war, for example, when Eighth Army was conducting the campaigns down in Mindanao and in the southern Philippine operations, he operated a very fast-moving type of warfare and did it quite ably.

General Eichelberger had ambitions to be the senior commander in the Pacific. He was, I felt, jealous of General Krueger, especially in the early phase when Sixth Army was conducting most of the operations. I think he sensed that possibly he should have been the senior commander.

I know he was disappointed, too, when hostilities ended, that General MacArthur didn't return home, because I think he had a strong ambition to be the senior commander over all the forces there, rather than the commanding general of Eighth Army under General MacArthur as Supreme Commander.

Q: What would you say was General MacArthur's evaluation of Krueger and Eichelberger? Whom did he rate more high] y, do you think?

A: I think he rated General Krueger higher. I think he had full confidence in Krueger. But in the early phase of our Buna operation in New Guinea, when we were having difficulties with the Japanese advancing over the Owen Stanley Mountain Range against Port Moresby, and the Australian troops were having difficulty with that advance, and our first American combat forces were suddenly thrown in, I remember he called General Eichelberger in and put him in personal charge of the offensive there and virtually told him that he had to capture Buna, or else. General Eichelberger interpreted that unless he did get Buna, and get it fast, it would be the end of the line for him. And I might say that General Eichelberger performed very well in pressing on to the Buna victory.

Possibly indicative of that, too, I think in the projected invasion of Japan General Eichelberger would be the one slated to head up the main force in the major Honshu [CORONET] landing operation after General Krueger on the Kyushu [OLYMPIC] operation.

Q: As far as not pressing ahead, what happened to Major General Edwin F. Harding, who was involved in that Buna operation? Removed, I believe?

A: They just felt that the American forces weren't making the progress that they felt that they should have made. However, I personally (and actually the only one on our staff) went up during the Buna campaign. I saw the forces in action. In fact, there's a citation in their recommendations for the Distinguished Service Cross in recognition of certain actions that I took.

But I don't think there's a proper concept among those who weren't there and didn't see it actually, which those on our headquarters did not do. As I have frequently said, they didn't do as much personal reconnaissance as I felt they should.

You have to visualize that here was the 32d Division, a National Guard outfit that had just come over to the theater. Then they were suddenly shipped by air over into the jungle, into combat; sent in there, you might say, just as foot troops with hand weapons. They had no artillery, very little in the way of transportation. I think they had seven jeeps in support of the whole division.

They had not been trained for the type of operation they encountered, against a well-trained Japanese force who were well set up in bunkers and heavily camouflaged. These were young troops with relatively untrained officers, at least inexperienced in that type of combat. They were not putting up a good showing, but it was not fully the fault of General Harding, the commander, in failing to have them take objectives that might otherwise have been taken more quickly by better trained and better equipped groups, with some artillery and/or tank support and transport.

In fact, with my having just come down from Bataan and seeing how poorly they were operating, I sensed some fear as to just how and whether we were going to succeed against Japanese troops. General Harding, as I say, had a tough job, and I don't think that the higher headquarters possibly understood fully the problems with which he was confronted.

Q: How about General Stephen J. Chamberlain?

A: General Chamberlain was both later a perfect chief of staff and initially a perfect head of the Operations Division of our headquarters. I think, considering the problems we had in our theater, with the difficulties of undeveloped terrain and distances, the problems of supply, and the problems of logistics, I think by reason of his background and his prior experience in the field of logistics, that qualified him even more for the important post as chief of the Operations Division. I think he had fine insight into all of the problems, and he coordinated personnel and staff and his agencies excellently. Most of the services that were involved, too, had a great respect for General Chamberlain and his judgment.

Q: You were saying yesterday that Charles Willoughby was a little bit strange-a very good intelligence officer, but a little bit of a strange character.

A: Yes. Charles was odd in some ways and in his characteristics. He was of foreign birth. And I know he changed his name from what it had been to his mother's family name, Willoughby. He spoke with a slight accent. He appeared to some to be a rather Prussianistic type. I don' t mean stem, but with a slightly foreign accent and his precise manner of speech. But I think he did a very fine job as G-2, chief of intelligence. One little characteristic that I sensed, I felt that in his formal presentations of an intelligence summary? the type of binding, the type of cover that he had on it and its form represented almost as much in importance as the contents or gist of the summary that he prepared on each intelligence situation.

He delegated to me, even though you might say the supervision of mapping is one of the phases of responsibility of G-2—Charles just took his hands off that completely and he delegated it to me as the chief engineer, every authority and every action pertaining to all mapping for the entire theater. He never did get involved or interfere at all. This gave the chief engineer complete carte blanche in that particular and important responsibility, which was also, incidentally, very helpful.

Q: How about Admiral Barbey?

A: Admiral Barbey was the amphibious force commander. I think he was well trained and prepared for that function, which in our theater was a very important one. Fortunately, insofar as the engineers were concerned, we had excellent coordination and cooperation with him.

In case there had been any sense of jealousy at the beginning in connection with the attitude of the Navy toward our amphibian engineers, that was very quickly overcome. Throughout the campaign, our relationship between the amphibian engineers and the Navy amphibious forces remained excellent. In fact, in his book and other reports he paid high tribute to the effectiveness of the amphibian engineer efforts during the war.

Q: Admiral Kinkaid?

A: Admiral Kinkaid. His biggest exploit with which I'm familiar was his handling of the old battleship force he had during the Leyte operation, where he cut off and wiped out the Japanese naval force that was proceeding up through the Mindanao Straits channel and which, if they had come through and come on up to the Tacloban area, could have effectively wiped out the whole operation through the destruction of the ships that were in the port ready to be unloaded. It would have actually, I think, brought about the defeat of the entire Leyte operation and set back the war over many months, if that force had been destroyed. That was occasioned by Admiral Halsey's going off, up toward the northeast in pursuit of the phantom Japanese naval force which was not there. With Halsey's force away and not carrying on his primary mission of protecting that landing, it would have been a very serious event.

Q: What about Admiral Halsey?

A: I admired Admiral Halsey very much. He was a very impressive, active, and able Navy Air commander and would do everything to seek out combat against the Japanese. I had sensed previously an attitude on the part of the Navy that, after the loss of the battle fleet at Pearl Harbor, the Navy wasn't ready to push as fast or as effectively as we felt that they should have done on other related naval activities that we had in our theater.

But Halsey was one who, I felt, was actually seeking combat. And he was a very, very able commander. He was greatly liked by all of his personnel and did an outstanding job of leadership. It was fortunate that all of that was not destroyed, as it might have been if our Leyte operation had been wiped out by either of the Japanese fleet forces.

Q: Did you ever have much to do with Chester Nimitz?

A: I didn't have much to do with Admiral Nimitz. I saw him on a few occasions in connection with the staff conferences that we had. We got along very nicely. I liked and admired him. I know that Admiral Nimitz had hoped that he, rather than General MacArthur, might be designated as the Supreme Commander just toward the end of the war for the final invasion of Japan.

There were some differences between MacArthur and Nimitz as to how certain phases of our campaign out in the Pacific should be conducted. I do know that over in the Central Pacific, with Admiral Nimitz controlling the Navy and being in an area that was closer to the United States, he seemed to be equipped with far more in the way of equipment, personnel, and such other items than we were out in the Southwest Pacific. He, too, had the large and new battleships and aircraft carriers, whereas we generally were furnished the old battleships, cruisers, and small escort aircraft carriers, but only for specific operations. I thought with their tasks, in the various areas in which they were operating, that they had more of everything for their particular tasks than did General MacArthur. I also thought, in comparison between the two, that MacArthur's operations were conducted much more effectively and certainly with less loss of life than were those carried on by the Central Pacific.

Q: Did you know General Robert Richardson, who was the Army commander in the Central Pacific?

A: Well, I'd known him when I was a cadet and he was stationed at West Point as an instructor. I knew him more as a senior officer at the Military Academy. I had little opportunity to have any contact with him during the war.

Q: Did you know General Thomas D. White, who was with the Air Force in the South Pacific?

A: Yes, I knew Tommie quite well. We had close association by reason of the relationship between the engineers and the Air Force. He was a smoother type than, let's say, General Kenney or General Whitehead, commander of the Fifth Air Force. I think everybody liked Tommy White. He ran the Army Air Forces in the South Pacific and later in our theater and did it extremely well. Insofar as the Engineer-Air Force relationship was concerned, it was very, very good and much smoother than it was, let's say, with the Fifth Air Force.

Q: Colonel Thomas Lane?

A: Tommie Lane was a very fine officer. He served as my executive officer and in our operations section. He was a very conscientious, very intelligent and articulate and able engineer officer and commander. I think he also was a very good analyst of problems and performed exceeding y well.

Q: Gene Reybold?

A: Gene Reybold was Chief of Engineers during the war. He came out to our theater, I know, on one trip. I don't think that he contributed anything personally, but it was a good opportunity for him to observe what our operations were like. On our presentation of these problems and recommendations toward their solution, I think he then tried to be helpful to resolve those problems and lent assistance and support to furnishing our requirements. But I think that the Chief of Engineers during major combat, whether in the European Theater or our theater—I think more would be accomplished if the Chief would get to such theaters early and more frequently to observe personally and to contact personally the senior commanders and engineers on such operations. It just goes along with the whole basic thought that I had throughout the war about the need for personal reconnaissance by senior commanders and by their staffs. I stressed that frequently in our own headquarters operations at GHQ.

Q: Did you know Thomas M. Robins who was the deputy chief?

A: I knew Tommy Robins not so much as deputy chief, more when he was in the Civil Works Division at the time I was on duty there. I don't know for sure whether he was actually in the Civil Works Division there, but he was active in civil works duty during my association with him. I respected him as a very able engineer officer with a strong technical background as well as his other administrative capacities and abilities.

Q: George Nold?

A: George Nold I had known because we had both served on the Engineer Rifle Team. I'd also known him elsewhere on engineer activities. In fact, he succeeded me at the University of Kansas as PMS and T [professor of military science and tactics] of the engineer unit there. So I had known George very well.

My next contact with him was on Okinawa when I went up there after Okinawa was turned over to our headquarters at the time they merged the Central Pacific into the Southwest Pacific under General MacArthur as Supreme Commander. I saw George up on Okinawa, and I had a good opportunity to observe his actions and the engineer activities up there. I regarded his general control and direction of the engineer forces there as being very, very fine. George was a very able officer.

Q: Herbert Vogel?

A: I had known Vogel as a junior engineer and knew of his assignment over to Europe on hydraulic research. I succeeded him later as a Freeman fellow in Europe. We had a common interest in the Corps of Engineers activities, particularly pertaining to hydraulic laboratory research and that phase in which he was later involved. He did a very fine job down at the hydraulic laboratory waterways Experiment Station, WES] at Vicksburg.

It was at my request that he was ordered out to our theater. I requested him by name and because there was a need particularly to bolster up, I thought, the engineers side of USASOS, which was giving us logistics support for engineer effort and overall effort. When Vogel came out, he was assigned to my command at ASCOM, and I designated him as a base commander for the Lingayen operation where he rendered an excellent performance.

Later on, by reason of his past experience and so on, he assumed virtually the office of G-4 in USASOS. He did very, very well. It was unfortunate that he was not promoted to a brigadier general, for which he was recommended, but promotions were stopped largely by reason of the movement of General Styer and his staff of general officers [Army Service Forces], who came out to our theater after the termination of hostilities in Europe. With that bloc of generals that came in, they stopped the allocation of further promotions to the general officer quota in our theater.

It's interesting to note that in General Styer's command, I think, they had two or three general officers placed over Vogel, practical y handling the same functions and responsibilities which he had. They also kept him on as an assistant, and he was still doing largely much of the work by reason particularly of his previous experience in the theater on those problems.

Q: What improvements, if any, could have been made in the standard table of engineer equipment that the Army had during the war?

A: We submitted many recommendations for changes in the tables of authorized equipment for the various engineer units. The situation may be quite different, depending on where operations are conducted, so that it is hard for us to say that setting out the tables of equipment for the units that we had operating under jungle conditions, in undeveloped areas, and under the conditions that pertained in the Pacific would necessarily be the same type of tables of equipment that should be allocated to the same engineer units operating in a different area.

However, basically, I think that with any engineer construction unit they ought to look at it from the viewpoint of giving that unit the maximum amount of equipment that can be capably handled; and also reviewing the tables of organization to provide for double-shift operation, certainly in time of war, in combat operation, because equipment is too valuable just to have it out there working on, let's say, an eight-hour basis.

When engineer construction units are used under high pressure during operations, the need is to turn out the maximum in the minimum amount of time and that can be attained only with increased capacity of equipment, rather than, let's say, more manpower. But it should be set and recognized that two-shift operation is almost standard-sometimes even three shifts.

Operators should be provided and trained based on that probable requirement, with provision of supplemental engineer equipment units, engineer maintenance units, and so on.

Q: If you were asked to identify the one engineer officer who most influenced your career, who would it be?

A: For the life of me, I can't think of anyone in particular.

Q: Who was the best qualified, technically most competent engineer you knew in the Corps?

A: Well, if you're talking about technical engineers, let's say in the technical and administrative field rather than during the war in combat and who didn't attain any particular position there, that was George Spalding. I got to know him quite well in the civil works field and respected him highly. I might say that he probably was one of those that influenced me in connection with my objectives and my ambitions to serve on in the Corps.

Q: That's where you and General Moore agree. Who was the best military officer as an engineer officer that you knew? Best soldier engineer?

A: Well, probably based on my observation of our operations in the Pacific, it probably would be Sam Sturgis. He was the active engineer officer in Sixth Army, our major combat command. He had the most opportunity to serve in that capacity in our theater. Others did very fine work in smaller operations with smaller responsibilities, and I might cite in particular my junior assistant in the early phases of the war, Major Bill Gay.

Q: Who was your best friend in the Corps of Engineers during your career?

A: Probably my closest friend was not one who had been in the Corps of Engineers, but whom we commissioned in the engineers, and that was Leif J. Sverdrup. Sverdrup later became a major general. He was my deputy and therefore we were very close together throughout the war. Probably second to him would be Sam Sturgis, the engineer of Sixth Army.

Q: How important do you feel your civil works experience was in preparing you for the wartime duties as chief engineer of the Southwest Pacific?

A: I think that was of tremendous, even supreme, importance. I can't stress the importance of the civil works responsibility the Corps of Engineers has as a means of preparing the Corps officer for responsibilities that will be their lot in time of combat or major war. During the war period, those who have any degree of leadership in those operations must have had some background or preparation in heavy responsibility of working on matters or projects where time and materiel, manpower, and other administrative and executive controls were involved. I think the civil works duties a Corps of Engineers officer may undertake during his career are immeasurably fine preparation for those later duties.

I have in mind, let's say, officers of similar rank in other branches just going through their normal peacetime military functions. Then when war comes they are promoted to assume great and heavy responsibilities. I sensed that in most cases they had not had the training, preparation, or experience to equip them to handle such duties.

In fact, I've seen it in actual wartime operations later where I felt that some of the line officers in other branches who had to assume high command were not fully qualified for their task by reason of the lack of prior experience or preparation or training to assume such increasingly heavy responsibilities and duties.

Q: What particular skills or training do you think made engineer officers such excellent Army logisticians during the war?

A: Well, as I said, it's the experience that they have had, or should have had, and the responsibilities that they'd assumed on civil works activities. I think that some engineer officers probably hadn't or would not have had much civil works responsibilities prior to the war and were not as well prepared to assume such responsibilities later during actual war conditions under the expanded responsibilities and duties that they would then be called on to assume if they were advanced to higher office.

End of the War with Japan and Occupation

Q: Did the atomic bombings and the war's swift end in August 1945 surprise you?

A: Yes. The atomic bombing was a surprise to us. We had not been made cognizant of the advances there nor of the plans, even though we were ordered to prepare special hardstandings for the planes that came over with the atomic bombs prior to the dropping of them on Japan.

But I think everybody felt that Japan was nearing its end. Their navy had been destroyed; air force had been heavily damaged and largely destroyed. All their forces outside of Japan, certainly in our area, had been virtually exterminated.

As I understand it, just prior to the termination of the war, Japan had actually sought to seek an armistice, to discuss surrender. As I understand it, they transmitted that through the Soviet Union, with whom they were still on diplomatic terms. Instead of forwarding that, I think the Soviet Union sensed that here was an opportunity to actually get into the war. And particularly after the atomic bombs were detonated, it seemed that the Soviet Union then was definitely going to get into the war.

After only about one week's operation, it came off the big winner in taking over Sakhalin Island and the group of [Kurile] islands north of Japan, in taking the surrender of the Japanese troops in Korea, in taking up all their arms and armament there and making them available to their Communist associates in China and elsewhere, all at no cost.

It was tragic that the Soviet Union actually did get into the war when they did. If they had entered into it earlier and had helped or had been a helpful factor in it, then that would have been quite a different situation. But they did get in just in time to reap the spoils at no cost at all to them.

Q: You landed at Atsugi Airfield on 30 August with General MacArthur and proceeded to Yokohama. You then went on into Tokyo looking for headquarters facilities. How would you describe your feelings and General MacArthur's on that day?

A: Well, one of great satisfaction. Incidentally, incident to that, about a week before we flew in, General Chamberlain called me in and wanted me to head up a group of engineers to proceed up to Atsugi about a week before our projected landing there to check over the airfield and to make sure that things were prepared for these future landings. I would have been the first one of our GHQ to land in Japan.

When we presented that to General MacArthur, General MacArthur said, "No, we will not send Pat nor any general officer nor anybody above the rank of colonel." So we setup this little party of engineers under Colonel Charles P. Tench—he's retired now and living in New Orleans. They went in ahead to check over the airfield. We had sent a radiogram to the Japanese that we wanted a certain number of graders and dozers and whatnot available at the site. But they regretfully indicated that they didn't have them to furnish, indicative of the shortage of such engineer equipment in Japan. But anyway, our force did go in there and did check to see that the field was suitable, with minor improvements, for this projected landing.

After our landing and en route from Atsugi to Yokohama, it was interesting that the road on both sides was lined with Japanese troops, and all of them facing outward with their backs to us. Instead of being a sign of disrespect, it was a measure that they had taken so that these troops could watch against any possible attack from either side of the road against our convoy. We arrived in Yokohama without incident. Very shortly after we arrived, I approached General MacArthur to see whether I might go up to Tokyo to check on facilities there. Tokyo and the intervening area were not going to be open to us until the following week in order to give the Japanese time for the large force of troops that were stationed between Tokyo and Yokohama to be moved out for demobilization.

General MacArthur approved and my small group started out with two Japanese cars—General Sverdrup, a Japanese State Department representative, a Colonel Mashbir who spoke Japanese, and Japanese interpreters and drivers—and proceeded up from Yokohama to Tokyo to investigate conditions there.

It was interesting that on the way, halfway up at a railway station, the road was completely filled with Japanese troops who were waiting apparently for the train to take them on out to wherever they were being transferred. So there we went slowly with these two cars right through this mass of troops-two little islands in a floating sea of Japanese troops. All the troops did was make way and just look at us with curiosity. We then and there sensed that this was going to be a peaceful occupation. We did have our pistols with us and cocked. They were ready, but would not have been too helpful.

We got to Tokyo. We found there had been much destruction, checked in on the Imperial Hotel, and looked at certain buildings as possible future headquarter buildings. I also proceeded to the American embassy to check it out. It was then under charge of a Swiss couple who had been caretakers through the war. Inside the embassy there were crates of furniture and rolls of rugs belonging to Ambassador [Joseph] Grew, the former American ambassador. Here his possessions had all been prepared and packed for shipment. They were intact. There had been no looting, no ravaging of the area, no taking of these as spoils of war. There was bombing damage only to one small section of the embassy. All around the area there was complete devastation from our bombing, but the bombing had carefully avoided the embassy itself.

The Swiss couple told us that during these bombing attacks the Japanese around there would come up pleading to open the gates so that they could take refuge in the embassy grounds. They'd open them Up and let the Japanese in. When the air raid was over, the Japanese would politely bow, thank the caretakers for letting them into this haven of safety, and proceed home about their business.

I visualized that if the conditions were reversed and the Japanese were invading the United States and they had their embassy in Washington, I would not conceive that that Japanese embassy would have lasted very long. We'd have broken the windows and smashed it up and probably wrecked and looted it. This was one little incident that gave me an impression of certain things about the Japanese.

Q: Did MacArthur's appointment as Supreme Allied Commander or Supreme Commander, Allied Powers, alter your responsibilities any?

A: Not materially. Of course, it was our function to carry on the engineer effort in connection with the overall program in the Far East. One particular additional assignment we had was the Post-hostilities Mapping Program.

That project was falling on the engineers to conduct a vast mapping program of Japan, of Okinawa, of Korea, as well as getting as much information as we could on China. That meant also getting from Japanese sources such maps and records as they had.

Then we had the problem of reconstruction, and clearance of the ports in order to make accessible to American needs the ports and related facilities. There was also the matter of rehabilitation of the railroads that had been damaged and the roads, too, that had been severely damaged.

We also were to embark on a major airdrome construction program. The Japanese airdromes in Japan as well as those we had encountered in previous operational areas were of light construction compared to our requirements, short and narrow fields, so that there was a major program involved in connection with providing and improving those airfields. Incidentally, we also built the Haneda airfield, which is now the major Tokyo Airport, by connecting two small islands in the bay with massive dredged fill, a major operation, and providing the necessary auxiliary features.

We had a major task of providing quarters for the anticipated arrival of thousands of dependents of our armed forces. We prepared standard plans for those structures conforming to Japanese measurements and Japanese materials that we could use. We prepared a mass of plans for the various types of structures to be used in those installations.

We built several major projects, such as those at Washington Heights and Grant Heights for 800 and 1,200 families, small communities complete with utilities, schools, chapels, commissaries, clubs, and all facilities for a small community. We built several such areas throughout Japan.

We also controlled, as far as the engineers were concerned, the allocation of scarce materials and equipment between the civil needs of Japan and its reconstruction and also on the needs of the military for our work.

Q: Apparently in 1946-1947 you had some problem with unit commanders who decided to undertake special projects that were quite extravagant in some cases. Did this present a lot of problems for you as chief engineer?

A: We frequently had to clamp down on unit commanders. Here we were [the] occupying force of a defeated nation. And some of the commanders in distant locations were prone to try to give early priority to provision of officers clubs and other, let's say, luxury-type items rather than early basic needs of shelter and military-type construction, such as aitfields or depots or pipeline facilities. But we were able to handle it. As I say, we had a number of incidents where such corrective action had to be taken.

Q: You were telling me the other day about your involvement in saving the Japanese war art.

A: The engineers had been charged with war art activities during the war, although during the war some congressman introduced a bill prohibiting the allocation of any funds for such purposes and orders went out to the theaters to eliminate any such activity.

I opposed that. Our war art unit had four very fine artists; Captain Barse Miller; Lieutenants Freddy Vidar and Sid Simon; and a civilian artist. I decided to retain them even by devious methods. I had one assigned as my aide. I had used no aide, but I said to Vidar and Simon, " You're my aides, but all you are to do is to continue painting. " We sent Barse Miller to the Air Force, and he continued painting for the Air Force. Our civilian was taken over by *Time-Life* magazine.

When the war terminated we received instructions to gather up all the Japanese war art and to destroy it. I instructed our war art personnel to contact the Japanese. We particularly had contact with General Fujita, who was an eminent, internationally known Japanese artist. Indicative of the weight that had been given by the Japanese to war art, they had promoted this artist to be a brigadier general in charge of those activities. And they had some wonderful paintings, paintings of all types. So we amassed and collected all of them. However, I sensed that it would be terrible to destroy them, so I approached General MacArthur. I said, " We're gathering these paintings, but I feel that we should secure rather than destroy them, merely keeping them out of Japanese hands. "

He said, "All right, Pat. But I hold you personally responsible for them. " The Ueno Museum in Tokyo had a big wing where we carefully stored all of them. Months later, frantic calls came from Washington requesting if there were any items of war art that they be preserved to be sent on to Washington and other Allies—the Australians, the Soviet Union, and others who were also then seeking them.

In any case, the Japanese war art—a vast collection of paintings—in the face of orders from Washington to destroy them, was preserved. I think many of them were ultimately sent on to Washington, and the others where else I don't know.

Q: What prompted you to initiate the eight-volume history of the *Engineers of the Southwest Pacific* under Lieutenant Colonel George Meidling after the war?

A: Well, I sensed that it would be highly desirable to record in historical volumes—not primarily for public dissemination but particularly for use in our military libraries and military schools, the Command and Staff School, the Air Force Academy, the National War College, service and command headquarters, and so on—the experiences, the difficulties, and the problems that we met during the conduct of the war and the solutions taken; and in those volumes, too, to include recommendations for further improvements which might help those in the future, if, as, and when they were called on in war to meet comparable problems. I am proud of them. I think they have been very helpful. I also think probably they are invaluable sources of reference, possibly in related problems.

Q: They certainly are unique. That's the only thing we have.

In February 1946 the Western Ocean Division was established under Brigadier General L. D. Worsham, with headquarters in San Francisco and districts in Okinawa, the Philippines, and the Marianas, to handle construction. Did you recommend this organization?

A: Yes. As I think we indicated previously, we felt that with the termination of war there would be pressure from the States to bring the boys home. So here we were faced with a rapid demobilization of our experienced units. We had some replacements sent over but consisting largely of untrained troops. We still had a lot of military-type construction to be undertaken in Japan and Korea and with limited engineer troops.

With the major reconstruction that we needed in the Philippines and the plans to develop the Marianas and particularly Okinawa as a major base for our operations, we felt that it would be desirable to get the Corps of Engineers in its normal peacetime function of setting up an Engineer Department division and districts with the experience, knowledge, capacities, and potential that you have through the Chief of Engineers and the Civil Works Division organization, because they would then have access to skilled personnel, administrators, and engineer civil service personnel of experience. So we felt that they would be far better qualified to conduct that work than we would be trying to use limited numbers of American troops that were being, as I say, weakened or actually eliminated by the demobilization.

Q: MacArthur’s proposed reconstruction program for Okinawa, which was going to be the major American military base in the Far East, did not fare well in 1946 through 1948. It was constantly cut down or disapproved by Congress or the War Department. How did he react to these reactions?

A: I don’t think that he displayed any major disappointment. He and we just recognized that after the termination of hostilities there was a reaction in Washington to cut back on almost everything military, and that sort of went along with it. He tried still to pursue it as best we could with those limitations.

I might add that the district engineers had their own problems with the forces that they were able to bring over. The contractors’ forces that were brought over were not always well suited for operations under the conditions that then obtained. There were a lot of them who drank too much. Some of them were a little shiftless. I know the district engineers had trouble with some of the contractors’ forces that were on those projects.

Q: How did the establishment of a separate Air Force in 1947 affect your work?

A: It didn’t have any material effect on us. Our relationship with the particular commanders continued almost as per usual. I think the Air Force anticipated and actually used more Air Force personnel under their own control on the maintenance of the airdrome; but that had always been our policy.

As I had indicated to General Kenney during the war (and approved by General MacArthur), we wanted to have a centralized construction force that concentrated on whatever phase of construction, air or other, was most important; but that, as and when airdromes were completed and insofar as the maintenance phase of those airdromes was concerned, it would be our policy to allocate aviation engineer units or other units under their direct control for such maintenance responsibility.

Nonelection for Chief of Engineers

Q: What were your relations like with Raymond Wheeler, who was Chief of Engineers after the war?

A: They were excellent. I might tell a little story indicative of that relationship, indicative of such a relationship. I had known General Wheeler when he was a district engineer on civil works duty and I was in the Chief's Office. I'd also known of his excellent work during the war in the Southeast Asia Command. We'd had one or two joint conferences during the war.

But, indicative apparently of his feelings with regard to me, when he was about to retire as Chief of Engineers he wrote me a personal handwritten letter saying that he wanted me as his successor. He said that he felt that President Truman was favoring General Pick [Brigadier General Lewis A. Pick]. General Pick was Missouri River Division Engineer at that time, and with Truman having come from Missouri there was a close relationship between him and the contractors there pressing for Pick. I, of course, was doing nothing nor would I do anything to seek that office. In any case, Truman was President and wanted Pick. Wheeler wrote to me that he was going to defer his retirement and continue on duty as he expected that Truman was not going to be reelected, as everybody did; and that after Truman's successor came in, then he would retire. He thought that I then would be selected as Chief as the choice of the War Department.

Of course, Truman was reelected. Harry Vaughn, who was Truman's principal aide in the White House, served out in the Southwest Pacific. But he had been relieved and sent home by MacArthur, and he held a rather bitter hostility to MacArthur because of that. I think he personally wanted to be sure that nobody of MacArthur's group was going to be Chief of Engineers, and he particularly wanted Pick.

As I understand it, the board of officers submitting recommendations submitted my name at the top of the list, along with several others; and Pick's name was not on it. It was sent back by Truman with directions to include Pick.

After Truman's surprise reelection, I received word from "Spec" Wheeler that I was being ordered to Washington for conference. So I took references on several matters of engineering concern with me. When I got there, he told me of this situation. He wanted me to be Chief. He said he had arranged an appointment with General Bradley, then Chief of Staff; then with Kenneth Royall, the Secretary of the Army; and then with the President. That I was to meet them, I assume in connection with having them see who I was as potential Chief.

I did meet with General Bradley. He told me the same story, that the Army wanted me as Chief and not Pick and had therefore set up these appointments with the Secretary of the Army and the President. I saw Secretary Royall and he told me the same thing. He said he'd set up an appointment for me with President Truman. This was only a few days after Truman's reelection. I had a very fine meeting alone with President Truman, who asked about the situation out in the Pacific. Of course, I made no mention at all about the Chief of Engineers appointment because I, unlike others, had not been actively seeking it. I'd have been highly pleased and honored if I had been so designated. We had a very pleasant conference. He inquired about things out in the Pacific and sent greetings to General MacArthur through me, and after 20 minutes or so we ended the conference. I proceeded with my other functions and duties and conferences in Washington and returned to the Pacific. Shortly after that Pick was appointed Chief of Engineers.

Q: I think the universal opinion is that the engineers lost. General Pick is certainly not considered to have been very good.

A: I didn't think he was.

Q: After Pick's appointment, then you decided to retire. Did General MacArthur try to convince you to stay on?

A: No. He did try to convince me on one thing. Just prior to our departure, he had Mrs. Casey and me over to luncheon. Just about that same time I received a cable from the Indian government making a very, very fine offer for me to head up their Damonar Valley Project. It was very similar in size and scope to our TVA program—construction of dams for power and irrigation and so on. They offered me a very fine retainer, living quarters and staff, car, pension, and so on. They wanted me to proceed at their expense down to India for a conference on it.

But here we were, all packed up. Our household goods were on the transport. We were getting ready to leave the next day. He said, 'Pat, go down there and talk to them. You can't lose anything. " Then he said, 'Though you won't get on the transport, I'll send you on the *Bataan* (his plane) over to Hawaii and you can catch the transport there. You have nothing to lose. " But I'd been out in the Pacific for 11 years, so I felt that it was time to get back to US terra firma and see my family. My mother was ailing; so I declined and did not go.

Shortly after my return I was sent over as the American delegate to the Permanent International Association of Navigation Congresses [PIANC] to their session in Portugal. As representative there, I attended those sessions and then made a tour through North Africa and Europe, observing various engineer activities there prior to my return to the States for duty as division engineer of the Ohio River Division. It was not what I thought then was the ideal appointment, but I was ready to accept it and proceeded there.

I was there only a short time when I received several enticing offers for outside employment, so I decided to retire from the service and get into civilian activity.

Observations on Douglas MacArthur

Q: When you were in Japan during the early postwar years in the occupation, you got to see at first hand the impact of General MacArthur on the people in government. How significant was his personal role in reshaping Japan and Japanese society?

A: I think it was material. You have to visualize that here is the head of a conquering army that has just conquered Japan's military forces. We had stopped the movement of Japan into China and Korea and their Far East expansion program. Here was General MacArthur over their emperor. Their emperor, keep in mind, was not just the Pope, not just the bishop of England, but in their minds he descended from the deity and yet, here he had a mortal, an enemy mortal, placed over him directing his government.

The situation was extremely difficult. But in a very short time MacArthur was recognized as a great friend and, I'd say, a savior of Japan. They were prepared for a conquering army possibly to go in the way the Japanese did in Nanking in China where there had been rape, looting, and whatnot. But our forces went in relatively disciplined. We did not requisition food from the people, but instead brought supplies in, medical supplies and food to assist them. We worked on major reconstruction programs for Japan which were very helpful to them. We brought in critical supplies and so on to assist them.

You must keep in mind, too, that Japan was half women and half men, let's say. And here MacArthur put through a program whereby a woman, instead of being a chattel walking behind the husband, attained equality and even the right to vote. So that raised the level of womanhood, affecting half the population in Japan. And the women did not resent that.

Japan also had a large agricultural population, with many very small farms. A little plot of an acre, an acre-and-a-half, or two acres was considered a farm, instead of hundreds or thousands of acres as we had. But those little agricultural properties were largely operated by families who had been operating them maybe for some generations, but owned by others. They had to pay relatively high rentals on their holdings. Well, we put through a program whereby these small landholders could acquire ownership, with title to these lands, under a controlled purchase program. This large group of small Japanese farmers did not resent that, and I think felt very favorable toward General MacArthur for it.

Also, in the large labor force in Japan, striking was impossible. They did not have the type of labor organizations that we have. And I think to put a similar handicap on industry in Japan, we authorized the organization of labor unions and in fact encouraged them. And the vast ranks of labor appreciated that.

So when you win the support of women, agriculture, and labor, you've got the support of the great majority of the people. I think MacArthur's conduct of the occupation was a sample of his outstanding statesmanship. He commanded great respect.

Q: Do you have any additional comments to make about General MacArthur as you knew him and served under him?

A: Many of the general public sort of regard General MacArthur as one who had certain personal vanities and that he held himself above the rest of the crowd. It is true that he had certain little personal frailties. For instance, Ike Eisenhower was bald. Ike recognized it and went around bald. General MacArthur, realizing that the hair on either side grows long even while you're bald on top, would have his hair parted way over on one side and then sweep it across his bald pate. At his age, of course, it would have been normally gray, and I'm sure he had it dyed.

He was also very, very careful to assume a commanding pose under all situations. He had a wonderfully fine and masterful knowledge of the English language, and in using sometimes the precisely accurate though unusual word to describe something, people seeing or hearing these words of unusual usage sensed that he was talking above them rather than actually expressing in accurate words whatever the thought [or] action commanded.

But these were relatively tiny, petty, or personal frailties. He did have an outstanding intellect, a wonderful brain. He could react almost instinctively to any given situation. It was just as though his brain were a computer. A thought would come; it would go through in a matter of seconds-the same processes that are performed on a fast computer. He could analyze issues very, very quickly.

He also had a marvelous memory. He could read a telegram of several paragraphs and put it down. With his photographic mind, he apparently had a photographic imprint of that particular communication, and he'd walk up and down, discuss it by word and paragraph.

I think the way he conducted his campaigns in the Pacific is a great tribute to him as a military leader. When you compare the casualties of the various operations in which our forces were involved, as contrasted to the casualties in the Central Pacific and in Europe and the way they conducted the long and costly campaign up through Italy, as compared to the outstanding victory we attained in Korea by reason of the Inchon landing, cutting off all the North Korean forces and causing their withdrawal at no sacrifice of life as compared to the heavy losses we would have sustained if we had just tried to pursue and push them back up that peninsula. All of these are measures of what a real leader he was, both as a military leader in war and an outstanding statesman in his conduct of the occupation in Japan.

Q: I don’t think I have any more questions for you. If you want to make any additional comments, I’ll leave it up to you.

A: I think that’s probably enough. If and when you have this done and you want any corrections or any other information, there may be more opportunity at that time. Thank you.

Appendix A
"Toast to the Corps!"

Toast to the Corps!

In the words of General MacArthur, referring to our World War II operations in the Southwest Pacific Theater, he said, "It was an Engineers' War. "

Time magazine, describing the Southwest Pacific phase said, "The War in the Pacific is moving with the speed of the bulldozer, " indicating that Our advances were controlled by the speed at which our engineers could hew out and develop new air bases with each new landing operation.

Our engineers in the Southwest Pacific were a magnificent team.

- They embraced our topographic units for the mapping of this vast uncharted region.

- They included our engineer amphibian units which led our landings and conducted vita shore-to-shore missions throughout our advance.

- Our combat engineers with each division were invaluable in their vital engineer support in every combat effort.

- Our engineer construction type units of all categories set a miraculous record in their speedy development of air bases, ports, roads, petroleum storage and distribution facilities, hospitals, depots, utilities, etc. in jungle and other wholly undeveloped areas in each of our successive landing operations.

The engineer contingent in each such operation constituted a major portion of each landing force.

At the end of World War II, our engineers of all categories approached 300,000 in total strength with many more planned for the projected OLYMPIC and CORONET operations for the invasion of Japan.

Morale is a most strong element in any organization and a great factor in contributing to its success. In recognition of that, I developed a toast to our Corps of Engineers. It created a good natured rivalry with the other arms and branchs of the service and with my fellow associates on General MacArthur's staff — but strangely enough, it is true. It goes as follows:

> ***To the Corps of Engineers***
> ***The Corps Elite,***
> ***The Mental Aristocracy of the Army,***
> ***The First Forward, and the Lust Back,***
> ***The Corps Elite,***
> ***The Corps of Engineers.***

It is true that we are a ***"Corps Elite"*** as exemplified by the long record of accomplishment, both in our civil and our military operations, since our inception.

The phrase, ***'The Mental Aristocracy of the Amy, "*** really wows them, but through the years, the top graduates of the Military Academy were chosen for the Corps, and those who entered from civil life were subject to most difficult examinations as compared to entrants to the other branches.

In each operation we were ***"The First Forward and the Last Back. "*** Our amphibian engineers manned the landing craft in the forward ranks of our landing forces. Our construction as well as our combat units had high early priority in such landings to initiate their vital missions. After such landings the tactical elements could be withdrawn for rest and re-equipment after the area was secured, but the demands on our engineers, on their almost superhuman task of rapid base development, could not be spared until virtually the last minute before they were staged for their next such operation. In some of our combat operations in the dense jungle, our engineer bulldozers preceded the tanks, which in turn preceded the infantry — again first forward. In our withdrawal operations, as on Luzon after the Japanese landings, our combat engineers in their divisions and our "Casey Dynamiters Teams" were also the last back as they dynamited bridges or destroyed other facilities immediately followed the rearmost tactical elements of our tanks or infantry.

Thus, I again propose a toast to our Corps of Engineers.

Appendix B
“Muscle Shoals”
The Kansas Engineer

THE KANSAS ENGINEER

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Muscle Shoals

By Hugh J. Casey, 1st Lieut., C. E. (D. O. L.)
Professor of Military Science and Tactics, R. O. T. C.

IN addition to the military engineering functions allotted to the Corps of Engineers, U. S. Army, there are certain civil engineering projects with which this branch of the army is charged by Congress.

In the past there. may be listed among such projects the lay-out and construction of some of the first railroads in America, the Panama Canal, the Alaskan railroad and all the major river and harbor improvement throughout this country. At present, river and harbor improvement constitutes most of the civil engineering work of this corps. The hydraulic development at Muscle Seals on the Tennessee river is an instance of this class of work.

The Muscle Shoals project is a culmination of three important situations: first, the shortage of nitrates in this country; second, the necessity for improvement of the Tennessee river for navigation; third, hydro-electric development. We shall consider each of these contributing factors in order.

NITRATES

Nitrogen, forming four-fifths of our atmosphere is one of the commonest elements in our daily life. However, it is of little value in its pure state and is valuable only in the form of its chemical compounds such as nitrates. Vegetable life, and consequently human life, cannot exist without them.

In explosives, the same situation relative to the need of nitrates exists. Nitrogen in some of its chemical compounds is an essential constituent of almost every explosive necessary in warfare. Regardless of "the millions of men, who" to quote William Jennings Bryan "will spring to arms overnight," if there are no arms, explosives or equipment with which to arm, train and equip, they would be helpless under a swift attack by any modern European or Asiatic power.

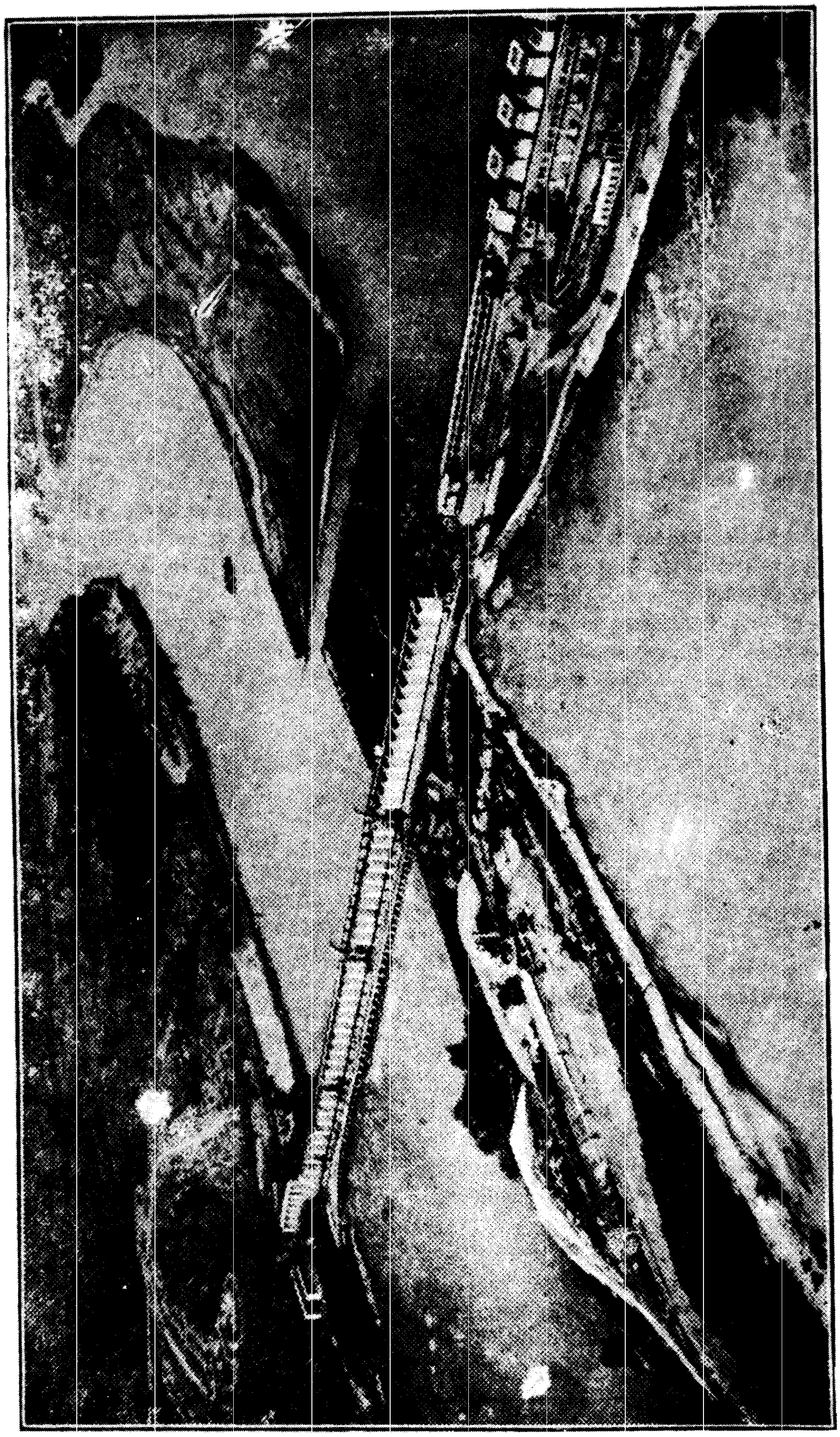
Before the construction 01 l-J. S. Nitrate Plants Nos. 1 and 2 at Sheffield, Alabama, close to Muscle Shoals, our nation was dependent on a foreign country for its supply of nitrates. In the northern part of Chile, lie vast fields of sodium nitrate upon which we have depended for our nitrate supply. This meant that in the event of war with a superior naval power or with a power conducting a ruthless submarine campaign, our freighters and transports would be cut off from communication with Chile and our supply of nitrates would cease. Without nitrates, our surrender would be but a matter of time. Nitrogen may be obtained in the form of ammonia and ammonia sulphate as a by-product in the process of making coke or gas. However, it would not be feasible to construct and hold in times of peace the additional coke ovens necessary to furnish sufficient nitrates for war requirements. Animal and vegetable refuse furnishes another source for nitrates but in insufficient quantities. It is better adapted for agricultural demand as a fertilizer.

There are at present three commercial processes for the obtaining of nitrogen compounds.

The arc process burns the nitrogen in the air by using a number of large electric arcs in an air current, thereby forming the base for nitric acid. A great quantity of cheap electric power is required to make this process commercially practical.

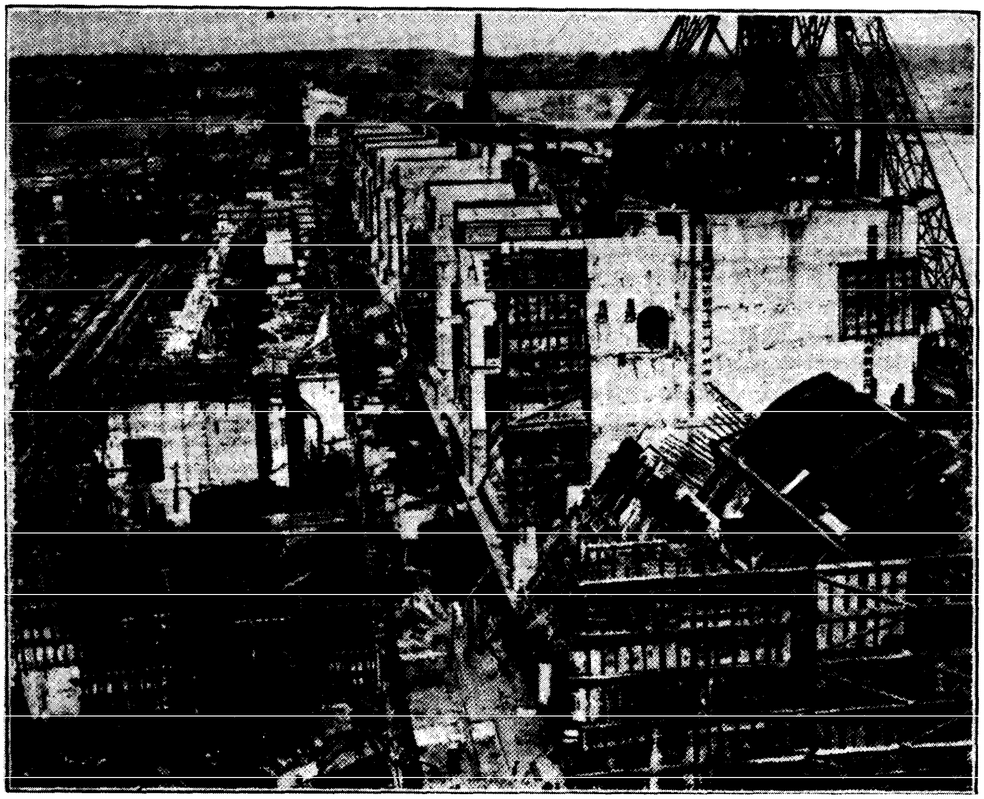
The Haber process, which was Germany's salvation in the World War, consists of the uniting of nitrogen and hydrogen under very high temperatures and pressures to form ammonia. This is the process used in Nitrate Plant No. 1 but it was not commercially successful. Since the construction of this plant several improvements have been perfected in the Haber method, so that with certain alterations in the plant, nitrates may be commercially produced there.

The cyanamide process, which is that used at Nitrate Plant No. 2, is as follows. Limestone, $CaCo_3$, obtained from the government quarry at Waco, a short distance away, is burned in rotary kilns to form lime, CaO. Coke, made from coal obtained in the mines of this region, if mixed with the lime and heated to very high tempera. tures in electric furnaces, to form calcium carbide, CaC_2. This is ground to a fine powder.



AERIAL PHOTOGRAPH OF WILSON DAM

Pure nitrogen is then obtained by liquefying the air and boiling off the nitrogen which boils at —195.5 degrees C., whereas oxygen boils at —182.5 degrees C. The nitrogen then passes thru the carbide which is heated to 2000 degrees l?. by an electrically heated carbon pencil, forming calcium cyanamide, $CaCN_2$. This after being washed is ground to a fine powder and charged into heavy walled steel cylinders, called autoclaves, containing caustic soda solution. Steam



VIEW OF CONSTRUCTION WORK ON WILSON DAM

is then introduced and the pressure raised to fifty pounds to form ammonia, NH_3. Ammonia and air are then passed thru a platinum guaze catalyzer which is kept heated to a red heat thereby forming nitric oxide, NO, which on cooling forms nitrogen peroxide, NO,. This gas is passed thru large towers in contact with water to form nitric acid, HNO_3. Ammonia gas, NH_3, and nitric acid, $HN0_3$, unite to form ammonium nitrate, NH_4NO_3,

Explosives such as smokeless powder, dynamite, nitroglycerine, triton, picric acid, and ammonium nitrate and commercial fertilizers such as ammonium nitrate, ammonium sulphate and ammonium phosphate are manufactured from the above derivatives.

The above process requires over 6800 kilowatt-hours of electrical energy per ton of ammonium nitrate produced. Therefore, in order to maintain such a war-reserve plant in time of peace for the manufacture of commercial fertilizer, a source of cheap electric power in addition to the raw materials, limestone and coal, was necessary. The site at Muscle Shoals combined these essentials and was selected for the above reasons.

With the supplies maintained as a war reserve and those turned out at this plant, an army of 1,250,000 men may be continuously supplied with ammunition. Additional plants may be erected on this site after the declaration of war should the need therefore arise.

NAVIGATION

The question of water transportation is another vital factor in this project.

The Tennessee river extends from about 41,2 miles above Knoxville, Tennessee, for a distance of 652 miles to where it joins the Ohio river at Paducah. It is a vast, potential navigation system.

With an adequate means of water transport, the tributary territory is capable of very intensive development. The lowlands are fertile and capable of raising huge crops. The mountainous or broken country contains timber, great mineral wealth in iron, coal, limestone and lead. Chat a-nooga, Knoxville and Harriman are manufacturing centers which would be further developed with improved transportation facilities on the Tennessee river.

The greatest obstruction to navigation on this river is the system of shoals extending to Florence, Alabama. In this relatively short distance, the river falls 134 feet. These shoals are commonly known as the Muscle Shoals. They consist of a hard flinty rock strata which has resisted erosion and has caused the river to widen out to two miles in places with a resultant shallow depth.

At this point, a word about the two general systems of river improvement might not be amiss. One method is that of channeling in which the object is to so direct and regulate the channel of the river that it will scour out its own path and furnish sufficient depth for navigation. This is accomplished principally by dredging and by bank revetment. The Mississippi river is an example of this method of river improvement. The other principal method is that of damming the stream at intervals thruout its length so as to raise the water level of the river. This is accomplished by a system of locks and dams, weirs or wickets. An excellent example of this type of improvement is the Ohio river. Combinations of both methods are frequently used.

As early as 1831, the state of Alabama with funds derived from a Federal grant of land of 400,000 acres tried to improve the Muscle Shoals section of the Tennessee by putting a detour system of canals and locks around this obstruction but it was not successful,

The present plan of improving the Tennessse river was adopted by President Wilson, Feb. 23, 1918. A six foot channel at ordinary low water will be maintained from the mouth of the river up to Florence where the Muscle Sheds system is encountered. At Florence, Dam No. 1 will be constructed to provide six feet depth of water between it and Dam No. 2, two miles upstream, It is purely a navigation project as no power will be developed.

WILSON DAM

Dam No. 2, or Wilson Dam, is the major project in this system, It is the largest dam in the world, being almost a mile long and one hundred and thirty-seven feet high. Thirty-six million cubic feet of masonry go to make up its vast bulk.

It will provide a lake of a minimum depth of six feet for a distance of eighteen miles upstream, thereby taking navigation over the worst obstacles of the Tennessee river shoals.

The dam is made up of a power house 1250 ft. long, a dam or spillway section 3050 ft. long and a two stage lock system having a total lift of 93 feet.

CONSTRUCTION

In the construction of the dam, six temporary coffer-dams of a total length of two miles had to be constructed. These coffer-dams were made up of timber cribs loaded with rock and sealed with clay.

Numberless water-bearing seams and clay pockets were encountered in the foundation and adjoining bluffs. In one instance alone, a tunnel 1400 feet long had to be dug thru a water-bearing seam. All the clay encountered was cleaned out and the cavities were filled with concrete to make all waterproof.

A large central concrete plant was erected on Jackson Island in the center of the river. A construction bridge was built paralleling the dam site, bearing railroad tracks and tracks for seven huge construction derricks to facilitate the transportation and handling of materials. A lumber yard was erected to handle the millions of board feet of form-work necessary. Five thousand men are working day and night on the construction of this dam. The question of systematic supply of cement, lumber, sand and the thousand and one other essentials was a huge problem in itself.

LOCKS

The locks are located on the north bank of the stream, each being 60 feet wide, 300 feet long, and providing a lift of 461/.. feet for vessels up to 7 1\2 feet draught.

The gates on the upstream end of these locks are of unique construction. Watertight steel boxes, 60 feet long, 14 feet high and 6 feet wide span the lock. When empty, these boxes float keeping the headwaters out of the locks. When filled, they sink in their recess and permit the passage of vessels entering the lock.

A pair of standard mitering lock gates is used between the locks. They are hinged on the inner sides of the locks and meet in the center. When opened, they are contained in recesses on each side.

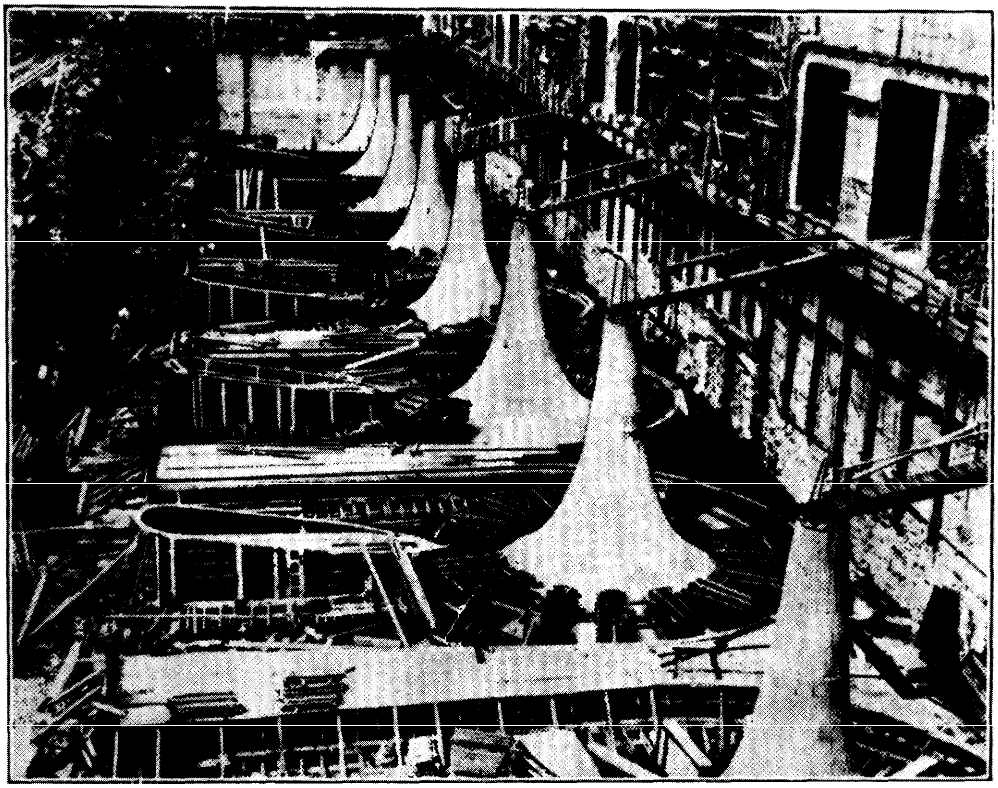
All gates and valves are operated by compressed air and are controlled from one central point in the operator's house.

DAM

The dam is made up of non-overflow sections and the spillway section. Both sections are unreinforced gravity structures, the foundations of which extend fifteen to sixteen feet into total width of 160 feet at the base. It extends to a height of 140 feet from the foundation to the operating bridge.

A non-overflow section extends for 180 feet from the locks. The spillway section is 3050 feet bed rock. At bed rock, the dam has a width of 101 feet which with an apron of 59 feet gives a in diameter at a velocity of 45 feet per second. Special precautions have to be taken to prevent destructive scouring action from these streams. A bed of concrete a yard thick and covered with huge granite blocks extends some distance downstream and serves to break up this torrent.

The power house containing the hydro-electric



SPREADING DRAFT TUBES—POWER HOUSE CONSTRUCTION

long and contains the gates and controls to take care of normal and flood overflow. When it is considered that the Tennessee fluctuates from a flow of 10,000 c.f.s to almost 500,000 c.f.s, it is seen that extensive provision must be made for flood control.

Flood waters are passed thru a series of 58 steel flood control gates, each 38 feet long and 18 feet high. A very unique system of controlling these gates allows one operator to open or close all of them within two hours.

To take care of normal flow in excess of power requirements, thirteen sluices are located in the five non-overflow sections near the power house. These sluices are circular conduits nine feet in diameter. They are protected by large screens upstream and controlled by a butterfly valve at the downstream end. When fully opened, a sluice discharges a stream of water eight to nine feet

generators makes up the remainder of the dam. Over all of this runs the Dixie Highway which allows all forms of traffic to cross the river on this dam bridge. (Literal interpretation.)

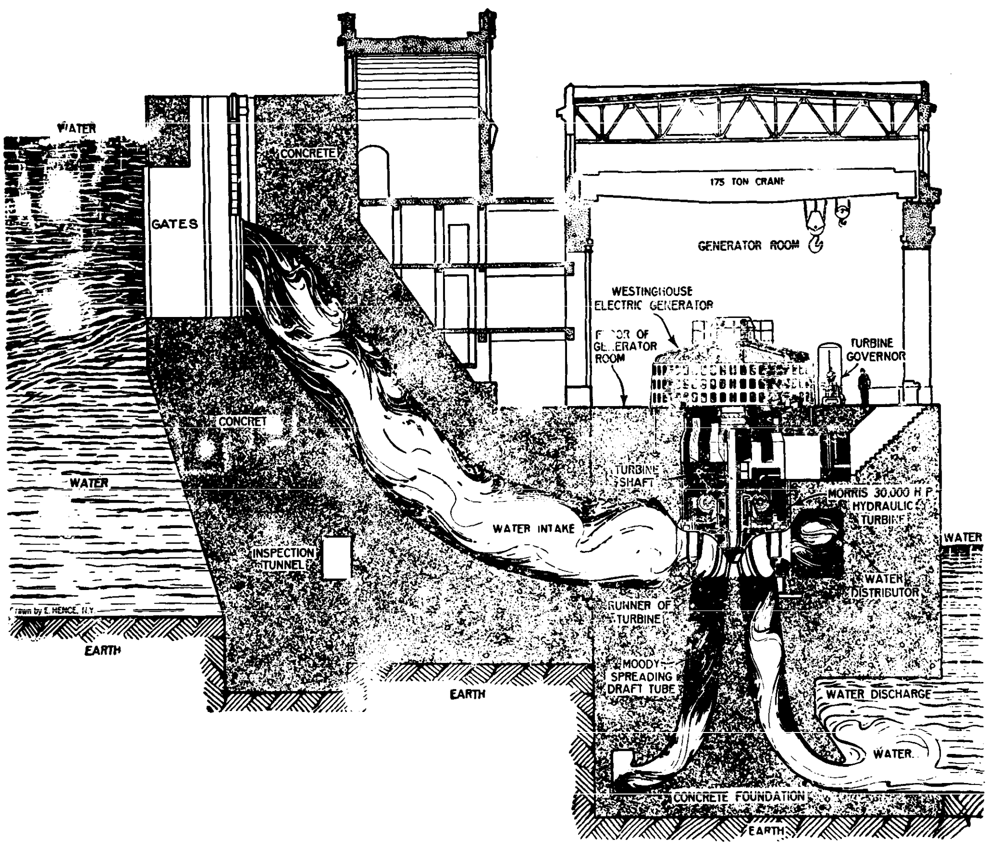
About eighteen miles above Wilson Dam, it is planned to construct Dam No. 3. This dam will raise the water 45 feet and allow navigation 65 miles further upstream. It will cost about $25,-000,000 and will develop from 34,000 primary horse-power to 250,000 secondary H. P. It will be longer than Wilson Dam but not as high. Several smaller dams will provide navigation for 156 miles up to Holes Bar. Above this point to Knoxville, the river is navigable to light draft vessels.

Even without nitrates or power development the increased water transport facilities provided on the Tennessee will be worth the total expenditures. It will furnish a necessary means of cheap transportation for a great industrial region.

HYDRO-ELECTRIC DEVELOPMENT

One thousand two hundred fifty feet of the southern end of Wilson Dam go to make up the power house. This building is 160 feet wide and 134 feet high. It will contain the turbines and generating apparatus for the hydro-electric development.

With the completion of this dam, 260,000 horsepower of hydro-electric generating apparatus will reinstalled. Tailrace excavation, draft tubes and the necessary construction of the power unit consists of a water turbine of the Francis type set vertically with a Westinghouse electrical generator rotated on the same shaft above it. Three water intakes, large enough for a truck to drive through, conduct the water to each turbine. These intakes join to form a scroll case where the water is distributed into the turbine buckets.' Control gates are provided at the head of each intake to regulate or cut off the flow of water. Steel screens prevent debris from entering and harming the turbines. A turbine governor regulates a system of wicket gates located around the runner so that the amount of water



POWER HOUSE SECTION

house sub-structure will be provided for the ultimate installation of additional generating apparatus sufficient to develop the total power to 610,000 H. P. It is believed that with the intensive industrial development going on in this region that a market will soon be developed that will absorb all this power.

POWER UNITS

A total of eighteen power units will eventually be installed, four of 30,000 H. P. and the remainder of 35,000 H.P. Each delivered to the turbine is regulated according to the amount of power required and distributed from each generator.

DRAFT TUBES

In order to discharge the water with minimum back pressure, a form of draft tube is necessary. In tests carried out in miniature, the Moody spreading draft tube gave the best efficiency. One each of two other types have also been installed to determine under identical conditions the rela-

(Contінzued to page 20)

ing magazines represented there, thus showing the weaknesses of each publication. Each delegate was given a style book for E. C. M. A. which had been carefully worked out by members of the group. Professor Gardner of the School of Commerce, spoke on advertising methods and practices. The talks by Professors Hyde and Gardner were to the point, full of practical information of real use to every publication, and gave the delegates something to take back to their staff. The discussion on advertising took up most of the time allotted to group business as it was the subject of greatest importance to the delegates. The regular committee reports and election of officers had to be rushed slightly because of the intense interest in the advertising discussion. It was a great convention and one the delegates will always remember.

Compare this issue of the Kansas Engineer, in which the staff has tried to embody the principles recommended by E. C. M. A., with the Jan., 1924, issue, and you will agree that there have been great strides toward the improvement of your publication.

Muscle Shoals

(Continued from page 10)

tive efficiency so that the results may be available to the engineering profession.

ELECTRICAL EQUIPMENT

The initial installation of generators w 11 consist of 25,000 K. V. A., and 32,000 K. V. A., 60-cycle, 3-phase, 12,000-volt, 100 R. P. M. Westinghouse type. The exciters for each will be a 250-volt direct connected and equipped with voltage regulators for their own control.

A house generator 940 K. V. A., 60-cycle, 3-phase, 2300-volt, 515 R. P. M. will provide power for the lighting system and station auxiliaries. A large storage battery is also provided for switch operation and emergency lighting.

With the installation of all eighteen units, 100,000 H. P. may be developed over 97 per cent of the year, over 300,000 H. P. for six months and over 600,000 H. P. for two and a half months.

AUXILIARY POWER PLANTS

In addition to the hydro-electric generating system, there is a steam plant at Gorgas, about 90 miles southeast of Nitrate Plant No. 2, capable of generating about 40,000 H. P., with a transmission line for this amount of power to the plant. There is also an auxiliary steam plant at Nitrate Plant No. 2 adjoining Wilson Dam where 80,000 additional horsepower may be generated, Coal is plentiful in this region so that these plants may be economically run during low water periods should extra power be required.

GENERAL

It is seen that Muscle Shoals is a project of vast importance to this country It is a very essential unit in the national defense system of this country due to its potential nitrate production. In peace times it will be a great aid to the agricultural industry in providing a necessary fertilizer at a cheap price. It will generate a great amount of electrical energy and furnish it at a low price to the industries in this section, thereby helping to develop another great industrial region in the south. It will open Up to navigation an important waterway which will become more and more important as this region develops.

Muscle Shoals is only one other successful accomplishment in the peace-time activities of the U. S. Army.

When a shop foreman in England, France, or Italy tells a workman how to do a job, the chances are that he will be understood and that the man will follow out the instructions.

But when a foreman in an American shop tells a man how to do a job he may understand or he may not, depending on whether the workman understands the English language.

The advantages of a working force using a common language are so many that other nations wonder how we are able to get any production. In some of our large cities there are as many as twenty different nationalities under a single factory roof.

Where there is a problem, there is a solution.

In this instance, American manufacturers who have been assimilating foreign labor over a period of fifty years have partially solved their problem by the extensive use of machinery and the subdivision of labor.

The task of making foreign labor productive has contributed largely to the development of standardized articles and processes. Workmen in these plants go through the same motions month in and month out.

This is the way out, but not the final answer.

The answer will not be obtained until we make some provision for the compulsory acquirement of the ability to speak and write English.

The universal use of a common language will do more than any one thing for the political and industrial development of the United States. We should all apply ourselves to its realization.

—Through the Meshes,

Appendix C
"Deadman Island Lock and Dam, Ohio River"
The Military Engineer

Deadman Island Lock and Dam, Ohio River

HUGH J. CASEY
First Lleutenant Corps of Engineers

DEADMAN Island Lock and Dam, located on the Ohio River 13.3 miles below Pittsburgh, Pennsylvania, has been under construction since May, 1927. The lock has been completed with the exception of the lock gates, operating machinery, power and operating houses, and the emergency dam, all of which are now being installed. The abutment and first section of the dam, embracing 372 feet, have just been completed except for three 20-foot spillway openings, and work is under way in the second cofferdam.

This structure will replace Lock and Dam Number 3, 2.3 miles above, and Lock and Dam Number 4, 5.3 miles below, both of which were completed in 1908. Dams 3 and 4 are the standard Ohio River type movable dams, whereas Deadman Island Dam is a fixed concrete dam of gravity section. It is similar in many respects to Emsworth Lock and Dam, which replaced movable Dams 1 and 2. It is one of a system of dams which, on completion in 1929, will furnish 9-foot navigation on 968 miles of the Ohio River from Pittsburgh, Pennsylvania, to Cairo, Illinois.

In the upper reaches of the Ohio River, the old movable type of dam has proved less desirable than the fixed type. The steep slope of the stream, the rapid fluctuations of stage, the dangers of running ice. and the shorter periods in which open river navigation conditions obtain, all tend to make the operation and maintenance of movable dams difficult. The advantages of open river navigation are at a minimum, and thd disadvantages inherent in the movable type of dam are always present. The fixed type of dam, in providing a fixed pool, at decreased cost, with greater ease of operation and maintenance, will supersede movable Dams Number 3 and 4.

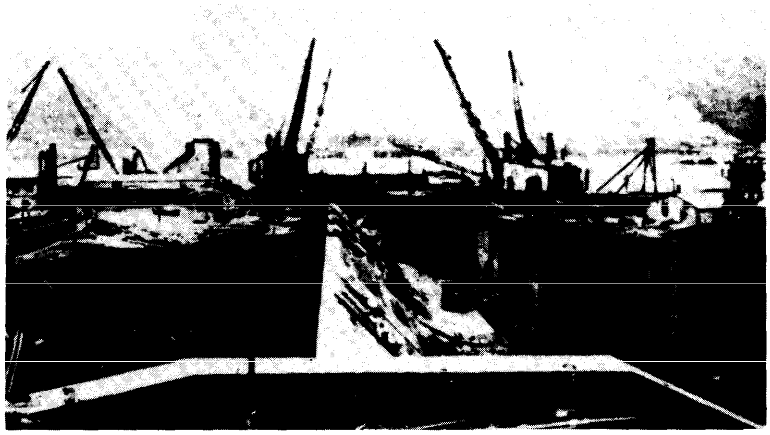
The crest line of the dam is located opposite Shields Station on the Pennsylvania Railroad. The lock is placed ideally on a comparatively straight reach of river. When one considers the typical Ohio River tow—70() feet in length—consisting of a towboat pushing from six to thirteen barges with loads up to 13,()()() tons, the desirability of a straight and easy approach to the lock can he realized, as it eliminates the dangers of being swept out over the dam, such as would particularly attend the location of the lock on a point. It will be notted that the dam is located at a slight widening of the stream, thereby allowing a long spillway-l,583 feet. As a result, a minimum obstruction to the flood flow of the river is provided and the dam only becomes " drowned out" at extreme flood stages.

The locks at this darn consist of the one standard Ohio River lock. 110 by 600 feet, and a smaller one, of the Monongahela River type, 56 by 360 feet, Each. lock consists essentially of a lock chamber, upper and lower gates, a culvert system for filling and emptying, gate - operating machinery, power and power transmission systems, mooring posts, capstans and lights. The lock chambers are filled and emptied by means of a longitudinal culvert system running through the walls with openings to upper and lower pools and to the lock chamber, controlled by butterfly valves. A power house with hydraulic turbine propulsion provides power for gate and valve operation, utilizing oil pressure transmitted through oil lines to the gate- and valve-operating machine. An electric generator, also turbine driven, furnishes current for light and power.

Both locks and dam are gravity-section concrete strulctures founded on rock. A firm sandstone was encountered here at elevations ranging from 654 to 665 along the land wall and at elevations varying only a foot from 654 for the middle and river walls. The crest line of the dam is at 690.

The walls of the lock consist of the land wall, middle wall, and river wall, all of which rise to elevation 705, providing a guard or freeboard of 15 feet above the dam. Each wall has two longitudinal passages or galleries running through it. The upper is a pipe-line gallery containing the oil, air, and water lines required for operation and service. The lower gallery is the culvert for filling and emptying the lock chamber.

The land wall is 1.936 feet in length. This distance includes the upper and lower guide walls, each 600 feet long. The guide walls are founded on concrete piers spaced 20 f'eet center to center, and ranging from 16 to 27 feet high. This construction is less cost]y than a solid retaining wall. and serves as adequately in guiding tows into the lock.



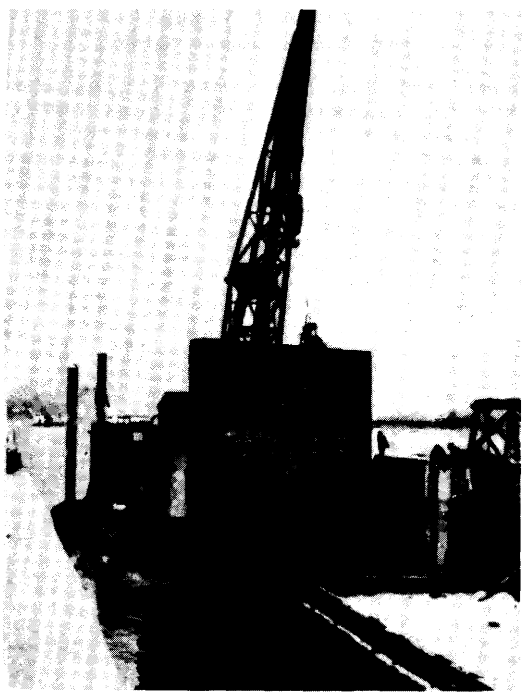
View of Part of the Dam

The middle wall, separating the two lock chambers. is 973 feet in length.

The river wall, 1,239 feet long, is made up of an upper guard wall 356 feet long, a lock wall proper, and a lower guard wall, 283 feet in length. The guard walls, like the guide walls, are also founded on concrete piers approximately 27 feet high, similarly spaced 20 feet center to center. The upper guard wall prevents tows in the upper approach from being swept out over the dam, while the lower guard wall protects a tow in the lower approach from the disturbing currents immediately below the dam.

The width Of base of the walls is 24 feet in the lock walls proper, and 13 feet in the guide and guard walls. The lock faces of all walls are vertical, while the outer faces are battered to give a width of top of 10 feet in the land and river lock walls. and of 5 feet in the guide and guard walls, except where extra space is required for houses, gate recesses, et cetera.

In order to protect the concrete walls from injury by scraping and battering of the present type of steel barges, slightly curved steel armor bands about 1 inch thick and 8 inches wide are embedded in the concrete along the walls where the greatest wear would be encountered. This armor is placed on the upper guide and guard walls beginning at approximately upper pool elevation, and on the lower guide and guard walls at and above lower pool elevation. On the chamber faces of the land and river walls, armor is placed beginning at lower pool elevation over the area extending approximately 50 feet downstream from the upper gate recesses and 50 feet upstream from the lower gate recesses. The upper and lower ends of the middle wall are similarly protected within the lock chamber. All vertical corners are armor protected.



Placing One of the Lower Lock Gates

The Lock Gates

The gates of both locks are of the structural steel mitering type. The upper gates are 27 feet, 7 inches high and the lower gates 40 feet, 10 inches high.

Each gate hangs vertically with its lower quoin end bearing on a pintle while its upper quoin end is held by a large pin. The pin plate is held by a pair of eye-bars (with sleeve-nut adjustment) anchored to the concrete. The gates, when mitered, bear upon the miter sill, a concrete structure founded on and keyed to rock. Guard sills are located a short distance up and downstream, respectively, from the upper and lower miter sills. These structures also act as emergency dam foundations. They are set at an elevation slightly higher than the miter sills, and serve to protect the latter from being struck and damaged by vessels, or protuberances projecting below the project draft allowance. These guard sills are of concrete, founded on and keyed to bed rock. The space between the upper guard and miter sills is filled and paved with 12 inches of concrete to elevation 676, or 14 feet below upper pool level.

The gates for the small lock are horizontally framed. The horizontal members, spaced vertically dependent on the head, are 24-inch, 80-pound I-beams framed to vertical quoin and miter beams of similar section. A diagonal eyebar extends from the upper end of the quoin beam to the lower end of the miter beam. The skin plate, 3/8 inch thick in the upper sections and 7/16 inch in the lower, is attached on the upstream side. Oak timbers are bolted to the quoin and miter beams for seals. Five horizontal, rectangular, butterfly valves (16 inches by 3 feet, 9½ inches) are placed in the lower end of each upper gate for flushing the lock chamber. Eight-inch oak fender timbers with sloped steel end castings are bolted to the downstream faces, to protect the gate, when open and in the gate recesses, against tows entering and leaving the lock.

The gates for the large lock are of the vertically framed type. Two vertical 48-inch girders, in addition to the 48-inch quoin and miter girders, divide the gate into three sections, each of which is strengthened by a pair of diagonal tension bars and three additional vertical 24-inch I-beams at 4 feet, 10 inches, center to center spacing. When the gates are mitered, the stresses from these vertical members are transmitted through the top girder, a 72-inch built-up section, to the lock walls, and through a 48-inch bottom girder to the miter sill.

Special provisions are necessary in the construction of the miter sill for the large gates. The miter sill is anchored by 1¾-inch bars, which extend through the concrete sill foundation 7½ feet into bed rock, in which they are grouted under pressure. After the concrete in the sill foundation has set, and before the sill is finally placed, the anchor rods, which are inclosed in a 3-inch pipe, are subjected to a unit tensile stress of 20,000 pounds per square inch by tightening on the upper sleeve nuts. The rods are then grouted in the 3-inch pipe and the sill placed. Were this not done, cracks would develop in the concrete miter sill due to the elastic deformation (in excess of 1/8 inch) of the rods in the development of their stress.

The pintle upon which this gate swings is a 15-inch, semi-spherical nickel steel pin, set on a cast steel shoe. A phosphor bronze cup on the bottom of the gate bears upon this pintle.

Operation of the Lock

A longitudinal culvert system has been adopted in the Deadman Island Lock for the filling and emptying of the chambers. The culvert system had to be of ample size and capacity in order to fill or empty the locks (the larger one 110 by 600 feet being about 1½ acres in area with a normal lift of 13.75 feet) in a minimum of time. Other essentials were that it should equalize the water levels above and below the gates with a minimum disturbance of water in the chamber and the approaches during filling and emptying, and that the system of valves should be reliable, durable, and easily accessible for repair.

The culverts for the operation of the 110-foot lock extend through the land and middle walls while that for operation of the small lock extends through the river wall. Through the walls at the head of each culvert is a series of screened openings, 5 feet square, which taper to 4 feet square as they enter the culvert. The culvert is of sufficient size and structural shape to carry the water through the wall. A large butterfly valve near the head of the culvert below the intakes controls the inflow. A series of similar 3- by 4-foot openings, tapering out to 4 by 5 feet branch off from this culvert into the lock chamber. The culvert diminishes in size toward the center of the chamber as its flow capacity decreases. As the culvert approaches the lower end of the lock wall, it tapers out again to the same size it had at the upper entrance. Here it has a similar butterfly valve and a series of openings branching out from it into the lower lock approaches. The openings are all below draft line. The whole system is designed to fill and empty the lock with a minimum turbulence to water and disturbance to craft in the chamber and approaches. This system will fill or empty the lock in five and one-half minutes.

The valves in the large as well as in the smaller culvert are of the structural steel butterfly type operating on a horizontal axis. They operate on cast steel axles rotating on phosphor bronze removable bearings keyed to cast iron frames embedded in the concrete culvert. The smaller size, 10 by 12 feet, is identical with that installed in Locks 6, 7, and 8, Monongahela River. With the large culvert, consideration was given to the Stoney type of valve, which is more usual in this size, but the butterfly type was adopted for the 13- by 14-foot, 10-inch, culvert also. It should prove more serviceable than one of the Stoney type because of the smaller number of moving parts subject to wear and corrosion.

Recesses for bulkheads with shafts extending to the top of the walls are provided in the culverts just above and below the valves. Thus this portion of the culvert may be pumped out and the valve repaired or removed and replaced through its shaft without obstruction to the lock chamber or approaches. Bearings may be easily replaced. With proper preparation, the replacement of a blade should be accomplished within a day.


The Longitudinal Culvert

A hydraulic system of oil pressure lines is used for the transmission of operating power throughout the lock. Such a system is unaffected by floods and is particularly suitable where large forces and slow motion are encountered. This oil pressure operates hydraulic cylinders at each gate and valve in both locks.

Each gate or valve is operated essentially by a valve controlled piston operating in a hydraulic oil cylinder. To the piston operating the gate is keyed a gear rack which, in turn, propels the gate by a linked mechanism operating on a geared sector. The valve is operated by a piston attached to a rocker arm, in combination with a vertical strut extending down the valve shaft. The link mechanism for the gate is so designed as to give maximum gate travel when minimum force is required and similarly maximum force at slow movement when it is required at the terminations of gate travel. Likewise, the rocker arm and strut for valve operation are designed to give the maximum force near the open position where such force is required with the butterfly valve. The rate and extent of movement of gate and valve are automatically controlled by the operation cylinders.

Control valves are provided on all three walls for several combinations of operation. Normal operation provides for operating both locks from the middle wall. The large lock may also be operated from the land wall and the small lock from the river wall.

The controls for the valves are located at the middle of each lock wall. The controls for the large lock gates are located just downstream and upstream respectively from the upper and lower gate recesses, while those for the small lock gates are located at their gate recesses. Thus the controls are arranged for maximum accessibility considering the requirement that the operator proceed to where he may check proper clearance for gate operation and non-interference of drift. The levers are arranged for simple and instinctive operation, being moved in the direction in which movement is desired. They are automatically locked when placed in the neutral position.

Pipe lines carry the pressure oil, service water, and air from the power houses. They extend from the power plants through inspection galleries above and paralleling the culverts to the facilities where the materials are used. The galleries are drained to lower pool, and are protected against all but highest floods. The pipes are carried on cast-iron brackets on the wall of the gallery. The main pipeline crossings of these lines across the lock chambers are effected through seven, 6-inch, cast-iron, lead-calked pipes, in a trench near the middle of the chambers. The trench is channeled through the bed rock, with small, 12-inch, concrete side protection walls rising to elevation 656.4 on either side. The crossings for the secondary 3-inch oil lines, for gate operation in the large lock, are in recess grooves down the gate recesses and in similar grooves in the miter sills. In

The Large Lock under Construction

the small lock, the oil lines for the gate operation are 2-inch lines in groove recesses down the gate recess and carried on small concrete piers across the lock chamber.

The air lines carry air for the operation of air tools and appliances. The water lines serve particularly for flushing and cleaning out the detritus and deposit, left by floods, from the galleries and other parts of the structures.

Two power houses are provided—one for hydraulic power, and one for the standby plant.

The power houses are small, concrete structures of pleasing architectural appearance, located on the river and land walls on a line with the dam. In construction, provision will be made for expansion joints at each monolith to eliminate cracks from expansion.

The power house for water-power operation is located on the river wall. There are three turbines, the independent intakes of which open directly through the river wall into the upper pool. Bulkheads are provided in these intakes for unwatering the turbines for repairs. The power turbines are of the vertical open flume wicket gate type. Two of these turbines operate vertical triplex pumps giving 250 pounds pressure in the oil lines for lock operation. The third, through a vertical shaft and bevel gearing, operates a 25 k. w. d-c horizontal electric generator for power for lighting and operating electric facilities such as capstans. For heads of from 10 to 14 feet between upper and lower pools, either turbine will drive either pump. For heads less than this, both turbines may be connected to drive either pump. Duplication of plant and operation thus provides a reserve against breakdown or trouble.

The power obtained from one pump furnishes only half that required for normal-speed gate operation. An accumulator is provided in conjunction with each pump to furnish the additional power. The accumulator is nothing more than a weight loaded plunger working in a vertical cylinder. When oil pressure is applied underneath this plunger, the weights are raised to the top of the cylinder. Thereafter, until they rest on the bottom again, they will exert the operating pressure on the oil line. Eight air cushions are provided in each accumulator to check the fall of these weights. This accumulates and supplies 179 gallons of oil at 250 pounds pressure, the additional hydraulic displacement required for normal-speed gate-operation.

The entire operation of the turbines is automatic. When power is used, the turbine is brought into operation by the opening of the turbine gates. These are opened by automatic control as soon as the accumulator plunger starts down, through a hydraulically operated piston connected to the gate shaft by a differential gear. The range of gate travel is controlled by a hand-control screw. The turbine remains in operation all the time power is being used and until the accumulator is again filled, when it stops automatically. This power is transmitted to the gate- and valve-operating cylinders on both locks by the high pressure oil lines.

In addition to the oil pumps for the lock operation, there are facilities in the power house for compressing air. A vertical, duplex, single-acting air compressor for 100 pounds pressure is provided which may be operated by either turbine. There is one air tank for storage in this power house, and two in the basement of the Administration Building, on the middle wall.

A vertical triplex water pump which may be connected to either turbine is also located in the power house to furnish water supply to the lock.

As a further power reserve for use, when, for any reason, the turbines can not be operated, a vertical fire tube boiler with a horizontal, duplex, pot-valve, steam-operated plunger-pump is provided in the power plant located on the land wall. The pump will be equipped with a pressure governor to maintain even pressure in the lines. Inasmuch as this plant will be called into very occasional use only, a simple but rugged plant, devoid of refinements, and of low first cost, is used. This plant will be used for initial lock operation during the construction of the dam when no difference in head and hence no water power will be available. Thereafter, it will be used only when the difference in head gets below 6 feet, or when, for any reason, water power is unavaiable.

Auxiliaries for water and electric power will also be provided as in the hydraulic plant. A steam-driven, vertical, simplex water pump and a 20 k. w. diesel engine d-c generator furnish these facilities. A 400-gallon oil tank affording a reserve storage of oil, and a work shop are provided in this power house.

The Administration Building is similar in structural appearance to the power houses. It is located on the middle wall where normal operation will be centered. The lockmaster's office, gages, shelter for operators, and storage for equipment and supplies necessary for operation are provided in this building. An air operated water pump furnishes its water supply.

The basement of this building embraces the pipe gallery in that section of the wall, and two large air receivers are emplaced in it for air storage in conjunction with the air compressors in the power plants. Coal is also stored here. A separate water-heating system is provided for each building.

Facilities must be made available in each lock for unwatering it for such repairs as may be required. Provisions for the necessary cofferdam are therefore made in the construction of each lock.

In the smaller lock, recesses are provided in the river and middle walls just upstream of the gate recesses and immediately above the upper guard sills, so that a girder may be placed across the top of the lock at this point. Timbers or needles may then be placed vertically, with their bottoms bearing against the upper guard sill, and their tops against this girder, to form an upper coffer. A foundation for a Poirée Dam of eleven trestles is provided just downstream of the lower gate. The foundation also serves as the lower guard sill for protecting the miter sill from damage by craft of excessive draft. The Poirée dam may be erected by placing steel trestles in the journal boxes, attaching wooden stringers to their downstream side and placing the needles in position. A lower cofferdam may thus be formed and the lock may be unwatered for any required repairs.

The span of the large lock is too great to permit the use of a simple girder as in the small lock. An emergency dam, consisting of a modified Boulée type of dam, is provided. The foundation therefor, which also acts as an upper guard sill to protect the upper miter sill, is located just above the upper gate recess.

The design is similar to that used at Emsworth Dam, except that here the trestles are raised in a direction parallel to the lock walls, whereas at Emsworth they are raised at right angles thereto. The recess for the end trestle, necessitated by the latter method, would interfere with the longitudinal type of culvert adopted. A recess in this location is also subject to severe damage from striking by tows.

There are ten trestles, each of which consists of two members, resting in a groove in the emergency dam foundation. A steel beam with its upstream end hinged to the foundation rests on a steel prop, the downstream end of which is similarly hinged. A chain attached to the free end of the prop passes through eyes in the middle and the free end of the beam. Each such trestle chain is attached by detachable clamps to the operating chain. As this chain is raised, it first raises the beam ahead of its normal raised position, while the prop slides up its under side until it reaches its seat. Light structural steel aprons, which are connected to the upper ends of adjoining trestles by pins, reinforce the structure laterally, and furnish a walkway for a bridge. A railing is also provided.

Two structural-steel derricks are provided to operate on either side of the lock in raising the trestles. The electric capstans will normally furnish the power for their operation.

The derricks are detachable and may be easily dismantled or reassembled. Recesses in the upper ends of the land and middle walls provide storage space above all but high floods for all the removable parts required for the emergency dam.

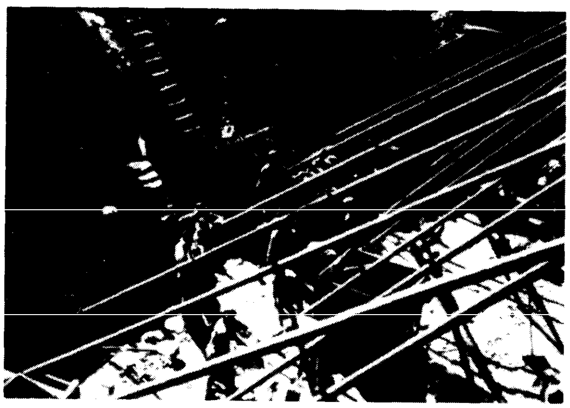
A means of propulsion for moving tows of barges in and out of the locks is desirable for rapid and efficient lock operation. This is provided by electric-driven capstans. One will be placed opposite the lower-gate recess on the middle wall, and two at the upper-gate recesses. The capstan at the upper end are also used for operating the emergency dam for the large lock.

A 3-foot guard fence is to be erected on the outer face of the river wall. This fence is detachable so that it may be removed easily prior to floods. It consists of 1½-inch, galvanized-iron posts, spaced 15 feet apart, to which are fastened two ½-inch, steel guy lines.

Check posts on the tops of the walls, and tiers of line hooks in the faces of the walls, are placed at short intervals through the lengths of both locks to facilitate mooring of tows at any place in the locks or approaches, at any stage, and for any type of craft. The posts consist of 7-inch, double, extra-strong, steel-capped pipe filled with a 2 to 1 grout.

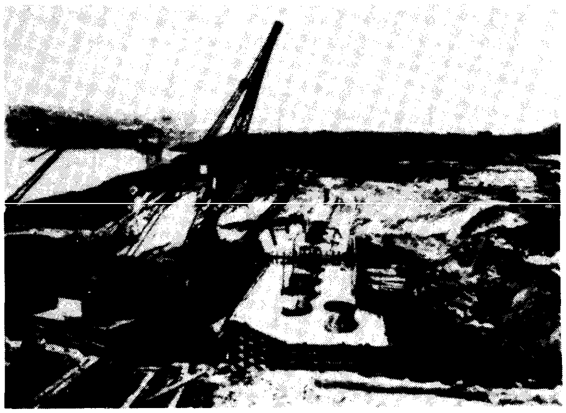
Ladders, consisting of steel bars placed in recesses and embedded in the concrete on either side, are provided at frequent locations where access from the walls to the water is desired. Similar bars, U-shaped and projecting from the concrete, are used for ladders in the shafts descending to the galleries. Such projections are not subject to striking, as would happen in a lock chamber.

The esplanade or space landward of the land wall, has been backfilled to elevation 705, and will be paved with 6- by 6-foot squares of 6-inch concrete over the area extending downstream from the emergency dam foundation to the Poirée dam of the large lock, and on the slope up the rail embankment to elevation 717, thereby preventing scour over this area in high water. A curtain of steel sheet piling is driven to bed rock at the upper end of the esplanade to prevent erosion by seepage. The areas up and downstream of the esplanade will be riprapped on slopes of 1 on 1½ and 7 on 11 respectively, to below pool levels.



Construction of the Upper Miter Sill

As an aid to navigation, for tows to tie to while awaiting their entrance into the lock, mooring posts are being installed at about 500-foot intervals on the left bank or lock side, upstream of the lock. These mooring posts consist of massive concrete anchorages (about 150 cubic yards of concrete), with a 6-inch check post embedded in their top. They are placed on a smooth curve at the new pool water line. At Emsworth and on the Monongahela, where similar ones have been placed, navigators have



Construction of the Abutment by the Caisson Method

found them particularly effective, especially in high water when the current is rapid.

Extensive dredging operations have had to be undertaken on this project. Not only did the upper and lower approaches to the locks have to be dredged, including the removal of much of Deadman Island in the lower approach, but a temporary construction channel, 500 feet wide, requiring 34,000 yards of excavation, had to be dredged and maintained between the lock and the dam cofferdams during the construction of the dam and prior to the completion of the lock, in order not to hinder navigation.

Dredging of the upper approach required approximately 107,000 yards over a distance of a third of a mile. This dredging was largely necessitated by the requirement that the locks be made available for operation prior to completion of the dam. This channel, therefore, had to be dredged to accomodate 9-foot navigation on lower pool elevation of Dam Number 4 (elevation 684.4), whereas new upper pool will be at 690. Because of the possibility of Dam Number 4 being down and pool elevation being lowered, this channel was dredged to elevation 674.0.

The lower approach, due to the proposed elimination of Dam Number 4, is being dredged to elevation 668.0, 12 feet below normal low pool. This will be dredged later to elevation 665 to provide a 9-foot depth under low-water elevation 674 existing when Dam Number 5 is lowered. This approach also encountered Deadman Island which added to its dredging requirements. It is estimated this dredging will total 225,000 yards. Dredging will be completed on or about August 1, 1929.

The 500-foot channel was dredged between the lock and the second dam cofferdam. (The dam is being built in successive cofferdams from the abutment side.) It is marked out by buoys and at night by lights. This is taking care of navigation at the present time and will continue to do so until the small lock is put into operation. Then it will be possible for the contractor on the dam to continue with his cofferdams across the river.

Notes on Construction of Lock

A box-type cofferdam embraced the entire work. The bulk of the fill used in the cofferdam was made up of material excavated in the wet by dredges and derrick-boats. A pump-boat housing five 12-inch, electrically-operated centrifugal pumps unwatered the coffer. It also pumped out after each recurrent flood, of which there were many.

Two 2-yard concrete mixers were set up within and at either end of the coffer. Construction sidings were built paralleling the railroad which passed the site and cement storage sheds were erected opposite the mixers and alongside these sidings. Cableways were erected from the cement sheds to the mixers. Sand and gravel were obtained locally in the river from a sand and gravel digger. Sand and gravel were charged into the mixers directly from the barges at each mixer by whirley-type derricks set up on the cofferdam. A reserve pile of sand and gravel was kept near the mixer inside the cofferdam for use when barges were not available.

The specifications for the concrete required for each yard: 5 bags of cement, 25 pounds hydrated lime, not less than 24 cubic feet of gravel, and sufficient sand to yield 15 per cent more mortar than was required to fill the voids of the gravel.

Tests were made frequently of the sand and gravel used. Based on the average of the tests, a mixture of 5 bags of cement to 11 cubic feet of sand and 24 cubic feet of gravel or 1:2.2:4.8 was used for the greater part of the job.

The water content was kept down to the minimum, consistent with getting a uniform plastic mass, and varied only with the type of form. It ranged from about 6 gallons per bag in the mass concrete up to about 7½ gallons in that used in slab or intricate form-work containing reinforcing, where extra workability was essential.

The concrete was transported in buckets carried on standard-gage flat cars propelled by gas locomotives. Whirleys, located at the point where the pour was being made, handled the bucket from the flat into the form. No concrete was allowed to be placed by chuting.

The excavation made in the dry was done by these whirleys as was the placing of forms. Eight whirleys were used during the height of the construction four operated in the large lock, three along the land wall, and one along the middle wall. Two operated in the small lock, and two were emplaced on the cofferdam tending the mixers.

The excavation of the lock chambers to final grades was left until the end of the job. Five dipper dredges were employed in removing the cofferdam and excavating both lock chambers to grade.

The inspection force on the job laid out the entire work, giving lines and grades for the contractor to follow. All metal-work was tested at the mills or shops, where made or fabricated, by the metal-works inspection force of the District Office. Sand, gravel, and such materials were inspected by the force on the job and mixing and placing of concrete were closely checked. Test cylinders of concrete pours were made about twice a week throughout the work.

The concrete tests showed up very well, the average crushing strength of twenty-eight-day cylinders ranging between 2,500 and 3,000 pounds per square inch.

A certain deviation from the plans had to be made in the upper guard and miter sills for the small lock. Inasmuch as this lock will have to be used by navigation prior to completion of the dam, which will result, for a long period, in an upper-pool elevation below the project normal pool of 691.5, it was considered necessary to lower these sills 4 feet. When the dam is completed, they will be raised to project elevation. Also a temporary superstructure had to be added to the top of the upper gates so that they could be hung from the pin plate anchorages 4 feet below their design elevation.

Lock Gates

The *Monallo*, a United States Engineer Department, 50-ton derrick-boat, was rented by the contractor for the placing of the small gates. Due to the current passing through the lock, an emergency dam first had to be erected by placing two large 12- by 18-inch timbers across the lock in the recess therefor, and placing 12- by 12-inch needles abutting on them and the guard sill. It was then a comparatively easy task for the *Monallo* to pick up one of the upper or lower gates, slung in a vertical position, proceed up the lock to the gate recess, and emplace the gate. A diver was used to clean out the pintle which had become filled with drift and deposit. He also checked the placing of the gate on the pintle. It is to be noted that these upper and lower gates for the small lock weigh, respectively, 34 and 45 tons.

Such a procedure with the large lock gates was impossible with the plant available. Instead, box cofferdams have been constructed, by the government, above the emergency dam and below the lower gate. The lock will be pumped out and the large gates will be erected in place.

As has been the usual procedure on all lock construction here, the pipe lines, operating machinery, and powerhouse equipment are being emplaced by hired labor. The personnel employed in the district for this work is skilled and experienced in these particular operations, since the same crew has emplaced practically all work of this type in recent years. Miscellaneous work, such as the emplacing of steel cover plates for recesses, erection of light poles and wiring, and bank protection involving paving of the esplanade will also be done by hired labor and government plant.

Deadman Island Dam

The dam is a monolithic, concrete, overflow, gravity section founded on rock. A comparatively level stratum of firm sandstone underlies the dam, varying between elevations 651 and 654.

The base, including the apron, is 60 feet wide. Beginning 8 feet from the upstream edge, an 8-foot key extends 5 feet into the rock foundation. The crestline of the dam is at elevation 690, thus requiring a dam almost 40 feet high. The apron, poured as an integral part of the dam, maintains an elevation of 657 the whole length of the dam.

The abutment is carried back some 160 feet into the right bank, which consists, at this point, of a high slag fill. The Pennsylvania Railroad has extended its property on this bank riverward by this slag fill to elevation 717. A great amount of excavation was required, therefore, in order to carry the abutment the necessary distance into the bank.

The abutment is an L-shaped structure, with a 154-foot river-arm starting 34 feet above the crestline of the dam, and an upstream arm carried back 72.5 feet from the dam into the bank. Expansion joints are provided where required in the abutment walls to prevent cracks from settlement, expansion, and contraction.

The river face of the abutment is keyed to rock by a 3- by 5-foot key. It rises to elevation 705. Five and one-half feet of the upstream abutment arm rests on rock, the remainder rising on a 1 on 1 slope, in steps of decreasing width to an extreme elevation of 717.5. The wall not on rock is carried on a pile foundation. A curtain of steel sheet piling beginning where the wall leaves rock is driven to refusal or to a maximum penetration of 30 feet.

An esplanade paving of 5- by 5-foot concrete squares 9 inches thick, with bituminous joints, extends from the upstream arm with a slight drainage grade riverward to 40 feet below the crestline of the dam. From here, a 3-foot paving of derrick stone extends downstream on a 1 on 2.33 slope to where it intersects a similar paving extending from the top of the abutment on a 1 on 1¼ slope.

It is believed that this type of abutment, tying the dam into the high bank encountered here, will effectively prevent any possibility of floods flanking the structure.

The Construction of the Dam

Work commenced with excavating in the wet by derrick-boats in the area of the first cofferdam. Efforts to remove by derrick-boats the slag fill in the area, which had to be excavated for the abutment, proved unsuccessful until a steam shovel was set up there. It loosened the material at a rapid rate so that, thereafter, the derrick-boats had no difficulty in picking it up for removal in scows or for use as fill for the cofferdam.

The type of cofferdam is of interest, inasmuch as it is the first of this type used in this area on river work. Steel interlocking sheet pile circles, 40 feet in diameter and 40 feet high, were driven to form the cofferdam. A wooden template was constructed for use as a guide for the driving of these circles. Four special T-connection piles were driven in each circle, spaced so as to furnish a pair of connections to tie to the adjoining circle at either side of the point of tangency. Thus, a double curtain wall could be driven to tie adjoining circles together. The circles and connections were then filled, and a berm thrown up on the outside of the entire cofferdam by the whirley type derrick-boats used on the job. A battery of two 15-inch, electric, centrifugal submerged-runner pumps was then set up and the cofferdam pumped out.

This type of cofferdam proved particularly effective where such a high coffer was required. A vertical face inside the coffer, which required no inner berm for strength and rigidity, gave the maximum working area with a minimum size cofferdam. The cofferdam was very tight and had a minimum of leakage. After floods, it was possible to unwater the cofferdam in ten hours with the two 15-inch pumps.

Work commenced on the abutment in cofferdam A and will continue in successive cofferdams across the river to connect with the lock. Sufficient 20-foot spillway openings will be left in the dam to pass high water so that it will not be necessary to flood the cofferdam at every little rise passing down the river.

Floating plant is being used for the construction of this job. All material and equipment are brought in by water. Cement is shipped in on sealed barges and sand and gravel are obtained locally. A mixer boat of 2 cubic yards capacity is used for the mixing of the concrete. Whirley type derrick-boats, supplemented by whirley derricks running on tracks on the upper and lower coffer arms, handle forms, excavation, materials, and concrete.

The construction of the abutment was interesting in that caissons were used. This is also an innovation on lock and dam construction in this district. Due to the danger of cave-ins from the huge fill rising 66 feet on three sides of the site of the abutment, the contractor felt it would be cheaper to construct the abutment by sinking reinforced concrete caissons rather than carry the excavation back as far as safety would require, or resort to heavy shoring. These plans were approved by the District Engineer under the condition that no increased payment would be made for additional material or operations required over that necessary under the original contract plans.

Two caissons were used with a 1-foot interval between them. The downstream caisson was a rectangular structure, 27 by 75 feet, and 30 feet high. The upstream caisson was also 27 feet wide and 30 feet high, but it was L-shaped so that it incorporated the base of the abutment within itself.

Each caisson had a steel chisel-shaped cutting edge and was strongly reinforced throughout. As the concrete was poured into it in successive horizontal pours, it sank into the sand and gravel bottom of its own weight. The sinking of both caissons was remarkably even throughout. Four circular openings, 7 feet in diameter, were left in the downstream caisson, and five in the upstream one. These were large enough for buckets to pass through to remove excavation from the chamber within the caisson. They were also adaptable for the application of bonnets to transform the caissons into pneumatic caissons, in the event it became necessary to work under air. Such a necessity did not occur however, as the caissons proved exceptionally tight. It was a comparatively easy matter to keep the chamber dry, by the occasional use of steam-siphon pumps. Working gangs within the chamber loosened material, where necessary, and moved it toward the center under the bucket openings, where the buckets removed it.

When the caissons had sunk 30 feet to bedrock elevation 654, the chamber was cleaned, a 3- by 5-foot key was channeled, and the chamber and cylindrical openings filled with concrete. Similarly the 1-foot gap between the caissons was also cleaned to rock and filled with concrete. The remainder of the abutment was then constructed upon the caisson base.

Progress in construction of the dam has been most satisfactory, considering the fact that work has been interrupted by nine floods, which have delayed the contract about a month and a half. Concrete is being poured on the dam in 42-foot monoliths. Three sets of forms, complete for each monolith, are being used for the entire job.

The complete installation at Deadman Island Lock and Dam will be representative of the most modern and efficient lock and dam development. It has been designed and constructed to take care of present and prospective Ohio River traffic. It will furnish a stable pool, with rapid and efficient lockages of tows through it, with minimum operation and maintenance difficulties and expense. It will give dependable navigation at minimum cost.

The Cofferdam under Construction

This view shows the first section of the cofferdam under construction. The circles are 40 feet in diameter and about 40 feet high. The connections between circles should be noted. The template used in driving is shown floating in the water near the pile driver.

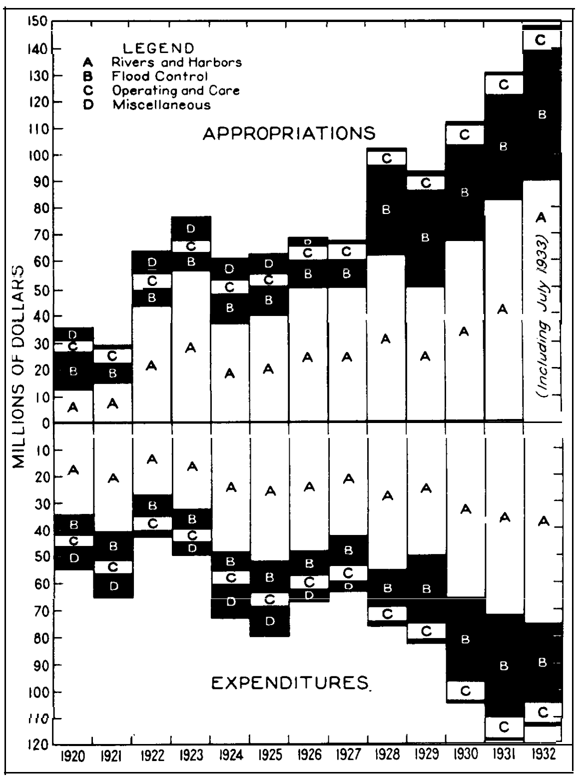
Appendix D
"Waterway and Flood-Control Activity"
The Military Engineer

Waterway and Flood-Control Activity

HUGH J. CASEY
First Lieutenant, Corps of Engineers

RECENT years have witnessed a tremendous increase in river and harbor and flood-control activity throughout our country. A review thereof will show not only to what great extent the Federal Government, through the Corps of Engineers and the Engineer Department, has assisted in relief to unemployment during the present depression, but also the economies that have been achieved and the progress that has been made in these public improvements.

In the years just prior to 1928, the annual appropriations for maintenance and improvement of river and harbor works had ranged generally from $40,000,000 to $50,000,000 per year. Operating and



Rivers and Harbors and Flood Control Appropriations and Expenditures, 1920-1932

care of completed locks and dams averaged about $5,000,000. Appropriations for flood control were about $10,000,000 per year.

In recent years, particularly since the authorization of the Mississippi River Flood Control Project in 1928 and during the present emergency, the picture has completely changed. Appropriations for maintenance and improvement of rivers and harbors have ranged about $60,000,000 per year with additional emergency appropriations since 1930 of $12,000,000, $22,500,000, and $30,000,000. Operation and care of completed locks and dams now cost about $7,500,000 to $8,000,000 per year. Flood-control appropriations have jumped to between $30,000,000 and $35,000,000 per year for Mississippi River and tributaries and $1,000,000 per year for Sacramento River, these resulting from the flood-control projects adopted by the Act approved May 15, 1928. Mississippi River flood control has similarly benefited by emergency appropriations for the relief of unemployment, having received $3,000,000 in the Emergency Act of December, 1930, and $15,500,000 in the recent Emergency Relief and Construction Act of July 21, 1932. In the past 5 years, total appropriations for river and harbor and flood-control activities were about $100,000,000 to $150,000,000 per year.

The increased appropriations during this critical period have helped the country in many ways.

Relief to Unemployment

In the first place, they have provided a vast amount of employment during a most critical period in the construction industry, when private work had been markedly decreased. It is difficult, however, to determine accurately the amount of additional employment so afforded. Some of the jobs were of short duration, while others extended through the year or longer. In general, for the same expenditure, a larger number of men are provided employment on a greater number of short jobs rather than on a few long jobs, even though the total man-days of labor may be the same.

Some jobs employed directly a much greater number of men per $1,000 expended than did others. The difference between the direct employment on two jobs costing the same total is, however, no measure of the relative employment provided. The job where a large portion of the money went toward the purchase of cement, steel, and such may have been even more efficient than otherwise by providing relief to unemployment in the industrial centers where these basic products are produced and where conditions may have been even more critical than at the site of construction. The portion of each construction dollar applied to the purchase of materials therefore served equally as well as that paid to the labor employed directly on the job.

Figures kept on a great number of river and harbor and flood-control jobs giving the ratio of one man-year of direct employment per dollar expended ranged generally from $2,000 to $6,000, with a scattering above and below these sums in some jobs. It is believed that on a conservative basis about one man-year of direct employment can be provided for $4,000 of river and harbor expenditure and for $3,500 of flood-control expenditure, assuming the usual cross-section of such work, including lock and dam construction, dredging, jetties and breakwaters, dikes, revetments, and levee construction. It is also conservatively estimated that at least one man is employed indirectly for every man directly employed. Based on these assumptions and taking into consideration that much of the work is seasonal in character and does not extend throughout the year, it is estimated that the Federal Government, through the Corps of Engineers, has provided employment, direct and indirect, to from 75,000 to 100,000 men per year, during the present emergency.

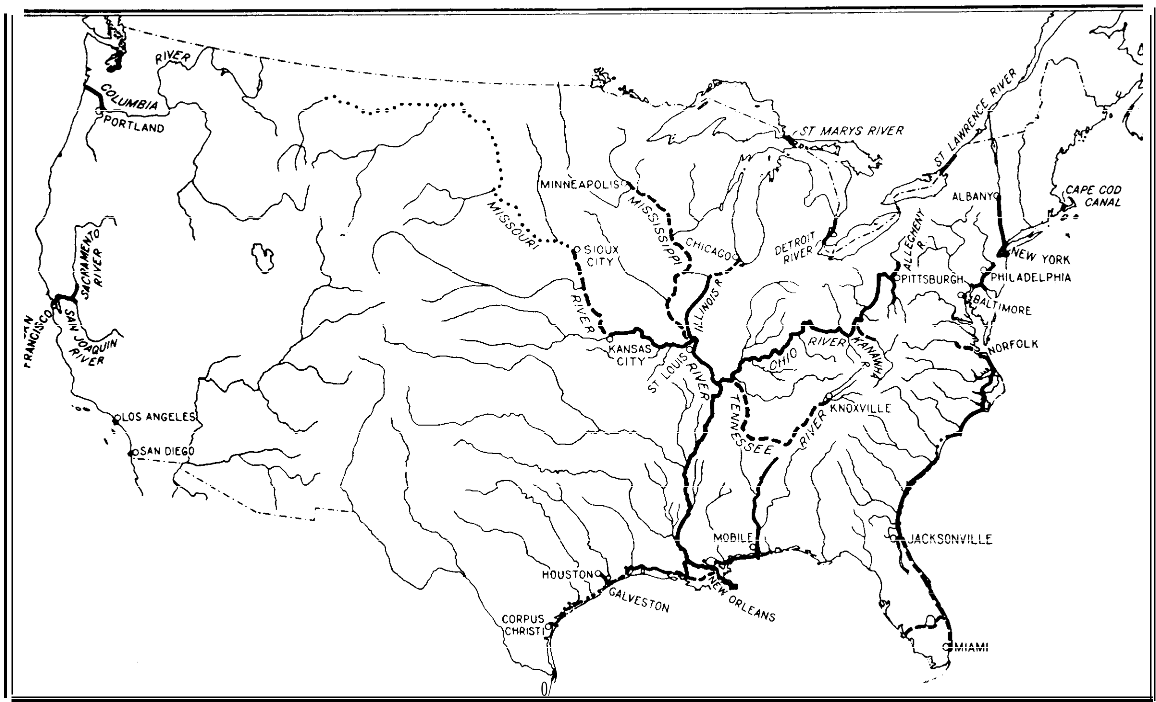
The provision for a 30-hour week for work being prosecuted under the $30,000,000 appropriation for rivers and harbors under the Emergency Relief and Construction Act of 1932 will materially increase the total direct employment for the money expended, as it will require, in direct labor, 1.6 men per week for each man on the present 48-hour week.

Economies Effected

In addition to providing relief to unemployment at a critical period when such relief has been of material assistance, the expanded program of activity has achieved material economies to the government by the prosecution, during a period of low prices, of authorized work, which, it has been previously determined, will effect savings in excess of their costs and which must some day be done anyway. To defer them to a period of high industrial activity would require a much greater total expenditure by reason of higher costs, put the government into competition with private industry in seeking construction forces and plant at a time when these are otherwise engaged on private work, and defer the anticipated savings accruing from projects which have previously been determined to be economic even on a higher normal cost basis.

By reason of the surplus of plant, labor, and materials now available, work can be done currently at prices much lower than any attained in recent years of industrial activity. This is illustrated by the following extreme examples, in which bids, materially below the engineering estimate, have been received. Figures are round numbers in units of $1,000.

Item	*Estimated Cost*	*Low Bid*
Atlantic Coast:		
Dredging Miami River, Fla...........	1,058	517
Construction of jetty, East Rockway Inlet	488	312
St. Lawrence River:		
Dredging, Ogdensburg to Lake Ontario	550	321
Great Lakes:		
Dredging Oswego Harbor............	575	270
Dredging (rock removal) Livingstone Channel, Detroit River.............	6,097	3,426
Dredging, Lake Nicolet, St. Marys River	630	318
Dredging, West Neebish Channel, St. Marys River	{1,200 { 600	{ 790 { 322
Dredging, Vidal Shoals, St. Marys River	1,100	595
Illinois Waterway:		
Dredging, Marseilles Pool............	1,395	886
Dredging, Dresden Island Pool.......	752	536
Dredging, Starved Rock Pool.........	701	380
Construction, Marseilles Dam.........	860	497
Ohio River System:		
Construction of Locks, Montgomery Island, Ohio River..................	3,065	1,554
Construction, Lock A, Marmet, Kanawha River	1,285	800
Upper Mississippi River:		
Lock in Twin City Dam, Minneapolis..	950	684
Mississippi River Flood Control:		
Levee, East Atchafalaya Basin........	336	232
Levee, West Atchafalaya Basin.......	{ 444 {1,467	{ 304 {1,139
Levee, Lower Tensas Levee District...	951	781
Levee, White River District..........	475	326
Gulf Coast:		
Dredging, Houston Ship Channel.....	800	427
Louisiana-Texas Intracoastal Waterway	1,100	394



Location of Important Waterway Projects

Material benefits will accrue to the Federal Government and to our industries, consumers, and taxpayers as a result of these savings. These Federal improvements will show even greater dividends than were anticipated when they were originally authorized as economic improvements, even under the higher unit costs then estimated. The savings achieved on individual projects have been applied to the prosecution of other authorized works not otherwise possible of execution at this time with the funds available, thereby resulting in additional employment and economies. The nation has been benefited by the provision of low-cost water-transportation facilities earlier than could normally have been anticipated. The protection afforded those affected by the flood-control projects is being advanced with resultant decrease in flood losses. Finally, the total bill for all these improvements will be less to the taxpayer than originally authorized and expected.

It is of interest here to note the progress made on the major projects.

Atlantic Coast

As we come down the Atlantic coast, the first large project we encounter on which there has been major activitiy in the past few years is the Cape Cod Canal, which was purchased by the Federal Government in 1928 at a cost of $11,500,000 and which has been maintained since as a free waterway. Tonnage has jumped from less than 1,000,000 tons to about 2,500,000 tons annually, valued at close to $150,000,000. Plans have been prepared and recommended to Congress for deepening and widening the channel and approaches, including the provision of a tidal lock 110 feet by 1,000 feet, which with improved highway and railroad crossings, is estimated to cost $23,250,000, to provide a safe waterway 30 feet deep for ocean shipping.

As we approach New York Harbor we find a recently completed 30-foot channel through Staten Island Sound, a deepened 30-foot channel in Newark Bay, extension of a similar channel in Jamaica Bay, a jetty at Rockaway Point nearing completion, and one at East Rockaway Inlet under construction. The major channels of New York Harbor, including the Anchorage channel, Bay Ridge and Red Hook Channels, the Hudson River, all 40 feet, and the rock-bottomed channel of the East River, 35 feet, have recently been deepened, widened, and extended. Work is about to commence on the 40-foot Buttermilk Channel project. These improvements have been pushed to take care of the large and valuable commerce of this port, which, during the past two years, has ranged between 106,000,000 and 120,000,000 tons, valued at approximately $10,000,000,000.

Extending north from New York we see the 27-foot channel project to Albany now practically completed, providing deep-draft ocean navigation to this new interior port. Commerce is growing rapidly, having reached 3,500,000 tons valued at $160,000,000 over the past year.

Further south, we find another major port, Philadelphia, on which the annual commerce ranges from 37,000,000 to 41,000,000 tons valued at $936,000,000 to $1,700,000,000. Here the Corps of Engineers has about completed and is actively maintaining the 35-foot channel in the Delaware River from the sea to Philadelphia, over a distance of 63 miles, and has extended a 20-foot channel to Trenton, New Jersey, 30.5 miles upstream.

On Chesapeake Bay are located two other large ports, Norfolk and Baltimore, on which major activity has been carried on during this period. Forty-foot channels of ample width have been provided in the entrance channel and at Thimble Shoals to Norfolk and Newport News, with adequate interior channels of 12- to 35-foot depth, to take care of the large and valuable commerce of this port, totalling 30,000,000 tons, valued at over $1,250,000,000. The main channel to Baltimore has been deepened to 37 feet over part of its width up to Sparrows Point and to 35 feet above. The remainder of the 37-foot channel has been advertised for contract so that Baltimore's heavy commerce, aggregating about 15,000,000 tons, valued at over $500,000,000, will be well cared for.

One of the largest projects on the Atlantic coast, in addition to these important harbors, is the inland waterway paralleling the coast. Cape Cod Canal and Long Island Sound provide a sheltered reach in the New England Area. A survey is actively under way for a canal across the state of New Jersey, to connect the Raritan and Delaware Rivers. The Chesapeake and Delaware Canal, the connecting link between the Delaware and Chesapeake Bay, has recently been completed to a 12-foot depth. At the mouth of Chesapeake Bay, the Norfolk-Beaufort section of the Intracoastal Waterway, including a large tidal lock in the Albemarle and Chesapeake Canal, has been completed, also providing a 12-foot depth. The section from Beaufort to Cape Fear River has been recently completed to 12-foot depth, excepting certain small rock areas of 9-foot depth. The link from Cape Fear River to Winyah Bay has been completed in part, and work on the uncompleted section is being advertised. The section from Winyah Bay, thence south to Saint Johns River, Florida, has been completed, providing depths of from 4 to 7 feet. Extensive work is under way on the reach from Jacksonville to Miami, where the project depth is 8 feet. The entire reach has been restored to the original depth of 5 feet, in this, the old Florida East Coast Canal, which was transferred to the Federal Government in 1929. The new project depth of 8 feet has been secured over 190 miles. Extension of the waterway south to Florida Bay has been recommended to Congress. A major project for navigation and flood control on the Caloosahatchee River and Lake Okeechobee drainage areas estimated to cost over $9,000,000, which will provide a light-draft waterway across Florida and flood protection to the Okeechobee Drainage Area, was adopted in 1930, and work thereon is actively under way.

A very extensive survey is actively in progress for a ship and barge canal across the Florida Peninsula. It is hoped that this survey will be completed by next year, and report thereon submitted to Congress at that time.

Gulf Coast

The important harbors of our Gulf coast, including Mobile, New Orleans, Sabine-Neches Waterway, Galveston, Houston, and Corpus Christi, have been improved and maintained. At Mobile, the new 32-foot project is well advanced, and all the work thereunder will shortly be under contract. The Passes of the Mississippi River, providing 30- and 35-foot channels to New Orleans and Baton Rouge, have been actively maintained to handle the commerce of 14,000,000 tons, valued at $500,000,000, which is now passing through these channels. The Sabine-Neches Waterway, providing 25-, 30-, and 33-foot depths, is practically completed and the 32-foot project to Galveston is nearly so. Widening of the 30-foot channel to Houston has been pushed and the Aransas Pass-Corpus Christi 30-foot channel was completed last year.

The Intracoastal Waterway skirting the Gulf coast has witnessed great activity over the past few years. The eastern portion of the section between Pensacola Bay and Mobile Bay has been completed to a depth of 9 feet, and the western portion is under contract. The 9-foot section between Mobile Bay and New Orleans has been completed. There has been a great amount of dredging activity on the section extending from New Orleans to Galveston, the work west of Galveston being dependent on fulfillment of conditions of coöperation requiring local interests to furnish rights of way. Construction of the Harvey Lock at the eastern terminus connecting with the Mississippi River is well advanced.

In every respect, the past three or four years have witnessed the greatest advance of any comparable period in the improvement of our Atlantic Coast and Gulf Coast waterways.

Pacific Coast

Maintenance and improvement of the major harbors on the Pacific coast has been most active in recent years. The project for San Francisco harbor has been enlarged to provide for an entrance channel of 45 feet in depth. At San Diego harbor, the depth has been increased to 40 feet, and work is actively under way on the enlargement of the channel facilities within the harbor. At Los Angeles and Long Beach harbors, California, construction of an outer breakwater 12,500 feet in length and estimated to cost in excess of $7,000,000 has been begun to provide additional shelter to this important harbor. The 26-foot channel in the San Joaquin River to Stockton is nearing completion. At Crescent City harbor, California, a rubble mound breakwater 3,000 feet long has been constructed. At Richmond harbor, a channel 30 feet deep and a training wall for the protection of the harbor have been completed. Construction of the rubble mound breakwater 1,300 feet long at Monterey harbor is well advanced. In the Columbia and Lower Willamette Rivers, through which important commerce totalling 7,000,000 tons of ocean traffic valued at over $300,000,000, in addition to an equal tonnage of inland river traffic valued at about $60,000,000, is carried, the channel has been deepened to 35 feet up to Portland, and major repairs in the raising and strengthening of the south jetty at an estimated cost of about $3,000,000 are under way.

Great Lakes

The major project in connection with the improvement of Great Lakes waterways has been that for deepening the downbound connecting channels to secure channels suitable for vessels of 24-foot draft, at an estimated cost approaching $30,000,000. The Great Lakes system is by far the major inland-waterway development of our country, with a commerce averaging annually for the past 10 years over 125,000,000 tons, valued at close to $2,000,000,000, and effecting transportation savings of hundreds of millions of dollars per year. Its improvement to provide a draft of 24 feet for the heavy laden ore carriers will effect large additional savings to our important steel industry. Work on this project is well advanced. On St. Mary's River, the project is practically completed and the work remaining to be done is under contract. Work has recently been started on the St. Clair River. Work on the Detroit River is actively under way, a contract having recently been let for deepening the rock bottom of Livingstone Channel, upon which a most favorable price, $2,500,000 below the estimate, was secured.

Our major lake ports have been actively maintained and many of them have been deepened and enlarged. Surveys have recently been made of all the large harbors with a view to their deepening to the extent required for the increased draft to be made available in the downbound connecting channels. New breakwaters have been completed, or nearly so, at Oswego, New York; Fairport, Ohio; Muskegon and Frankfort, Michigan; and Milwaukee, Wisconsin.

An important event materially affecting the Great Lakes system was the signing on July 18, 1932, of a treaty by representatives of the Canadian and American Governments for the construction of the Great Lakes-St. Lawrence Deep Waterway, based on the final report of April 9, 1932, of the Joint Board of Engineers. Subject to ratification of the treaty by the legislative branches of both governments and subsequent appropriation of funds, work will then be prosecuted for a joint navigation and power project, providing a channel 27 feet in depth in the St. Lawrence River to the Lakes. A section of this waterway was authorized in the river and harbor act of 1930, to provide a 27-foot depth between Ogdensburg and Lake Ontario, and work thereon has been actively under way and is expected to be completed this year.

Inland Waterways

The past three or four years have witnessed a remarkable advance in the improvement of our interior waterways. A connection between the Mississippi River System and the Great Lakes was authorized in 1930, at a cost of $7,500,000, by the extension of the 9-foot project on the Illinois River to include completion of the Illinois State Waterway, then under construction by the State of Illinois. The former Federal project to provide a 9-foot channel up to Utica, 230 miles above the mouth, has been practically completed, and the work on the completion of the five locks and dams in the Illinois Waterway section is well advanced, being scheduled for completion this coming spring. Through navigation between the Great Lakes and the Mississippi River system will shortly be dependent only upon the alteration by the state of Illinois of the bridges crossing the waterway, the alterations of which are also in progress.

Upper Mississippi River

The 9-foot project for the Upper Mississippi River from the mouth of the Illinois River to Minneapolis, at an estimated cost of $124,000,000, by the canalization of this river, was authorized in 1930. Work on this project has been actively under way. New locks have been constructed at the Twin City Dam, a lock and dam have been completed at Hastings, Locks Numbers 4, 5, and 20, located at Alma, Wisconsin, Fountain City, Wisconsin, and Canton, Missouri, respectively, are being advertised, and the construction of new locks and a dam at Rock Island is well advanced.

Ohio River

In October, 1929, the completion of the canalization of the Ohio River providing a 9-foot depth from Pittsburgh to the Mississippi, over a distance of 981 miles, at a cost approaching $118,000,000, was formally celebrated. This river is now carrying a commerce ranging from 18,000,000 to 22,000,000 tons, valued at close to $200,000,000.

A number of feeders to the Ohio River have also been the scene of great construction activity. On the Allegheny, locks and dams Numbers 4, 5, 6, 7, and 8, extending navigation of 9-foot depth up to Rimerton, Pennsylvania, at Mile 61 have been completed. New locks at 2 and 3, with a new dam at 3 have also been advertised. On the Monongahela River, the lock at Dam Number 4 has been replaced by a new structure, of large capacity adequate to handle the heavy and valuable commerce, totalling 25,000,000 to 30,000,000 tons, valued at $150,000,000 to $175,000,000, passing over this important stream, which, through provision of low-cost water transportation for coal and other basic materials used in steel, is one of the major factors in the Pittsburgh steel industry.

On the Kanawha River, another important feeder of the Ohio, construction of new locks and dams at London and Marmet is under way, to replace the old and inadequate locks and dams Numbers 2 to 5, inclusive.

A major project for improvement on the Tennessee River at an estimated cost of $75,000,000 to provide 9-foot navigation, over a distance of 652 miles to Knoxville, was adopted in 1930, and work on the first of these structures, the lock at Dam Number 3, has just been advertised. This project is a joint power and navigation project authorizing the Federal Government to contribute to the cost of any high dam constructed as a power development the estimated cost of the navigation structures replaced. For this reason, the construction of low dams at locations where power development appears feasible under the terms of the authorization, has been deferred pending receipt of applications under the Federal Water Power Act, for such power development.

Missouri River

The project for 6-foot navigation on the Missouri River from its mouth to Sioux City has been actively pushed. Contraction and stabilization works on the Missouri up to Kansas City are practically completed, and a 6-foot navigable depth over this reach will be available shortly. The reach above Kansas City to St. Joseph is the scene of present major activity. It is expected that, with the completion of the work now under contract, this reach will be about 85 per cent completed. As an index of the recent activity on the Missouri River, it should be noted that, of the $75,000,000 expended on the Missouri River project to Sioux City, two-thirds have been expended during the past 4 years. The work is therefore obviously being rapidly advanced.

Flood Control

The two important projects for flood control committed to the Engineer Department are those on the Sacramento River, California, and on the Mississippi River and tributaries. The present projects for both of these streams were authorized in the flood-control act approved May 15, 1928, and work has been carried on as fast as funds were made available.

The flood-control project for the Sacramento River is estimated to cost the Federal Government $17,600,000, including the refund to the State of California of the amount previously expended thereon by the state. This project provides for the enlargement of the river channel, for the construction of two cut-offs, and for the construction of auxiliary flood ways including necessary weirs and levees. Work thereon is being actively prosecuted with funds appropriated at the rate of $1,000,000 annually.

Mississippi River and Tributaries

The project for flood control on the Mississippi River and tributaries is the major single project of the Department. Its authorized cost is $325,000,000. Its principal features consist of raising and strengthening the main river levees below Cape Girardeau, Missouri, construction of a set-back levee in the vicinity of New Madrid to provide additional channel capacity during periods of flood, the raising and strengthening of levees on the south bank of the Arkansas and Red Rivers, the construction of protection levees through the natural overflow areas in the Boeuf and Atchafalaya basins in order to limit the area heretofore subjected to overflow in extreme high waters, and the construction of a spillway located just above New Orleans bypassing water into Lake Pontchartrain. Work on this project has been prosecuted at a high rate. The New Madrid Floodway and Bonnet Carré Spillway are about completed. On September 1, 1932, over 250,000,000 cubic yards of levee had been completed under the main river project, and an additional 15,000,000 cubic yards on tributaries and above Cape Girardeau. During the month of August alone, over 17,500,000 cubic yards of earthwork was placed in the levees. In this connection it is interesting to note that the total excavation by the French, useful in the construction of the Panama Canal, was less than 30,000,000 cubic yards and the total of the United States to the end of the past fiscal year, about 370,000,000 cubic yards in the construction and maintenance of the canal. Dirt is being moved on the Mississippi River at a rate never previously attained.

By every measure, in so far as river and harbor and flood control improvements are concerned, the past 4 years have loomed far and large as the greatest in our national history in new projects authorized, in total appropriations and expenditures made, in relief to unemployment and industry during a critical period, and in results achieved in advancement of our national program to provide coördinated systems of low cost waterway transportation and relief from national flood damage. The vast army of workers who have been engaged on this program have reason to feel a pride in their accomplishments.

Appendix E
"Cement and Concrete Studies on the Passamaquoddy Tidal Power Project 9,
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Cement and Concrete Studies on the Passamaquoddy Tidal Power Project*

BY HUGH J. CASEY†

In connection with the Passamaquoddy Tidal Power project, the design and construction of which were undertaken by the Corps of Engineers in May 1935 as a major work relief project under an allotment of funds from the Emergency Relief Appropriation of 1935, extensive cement and concrete studies were made.

DESCRIPTION OF PROJECT

Although small tidal power mills have been in operation in this country and in Europe for centuries, the Passamaquoddy project is the first large-scale tidal power project ever to have been undertaken. The Quoddy project was to harness the power in the high Fundy tides which prevail in the vicinity of Eastport, ranging from apogean neap tides of less than 9 feet to extreme perigean spring tides of almost 27 feet with mean tidal range of 18.1 feet. As may be generally known, it was the plan of Dexter P. Cooper, the original proponent of the project, to enclose Cobscook Bay and Passamaquoddy Bay, arms of the Bay of Fundy, from the latter bay by a series of dams, gate-structures and navigation locks. Between Passamaquoddy and Cobscook Bays a series of darns and a power house were to be constructed. (Fig. 1).

The plan of operation was that at and near high tide the gates to Passamaquoddy Bay would be opened and the Bay filled to near high tide levels. As the tide receded the gates would be closed. Conversely at and near low tide, the gates to Cobscook Bay would be opened and the Bay drawn down to near low tide elevation. Thus there would be a head produced between the two pools, available, through the interconnecting power house, for the production of energy.

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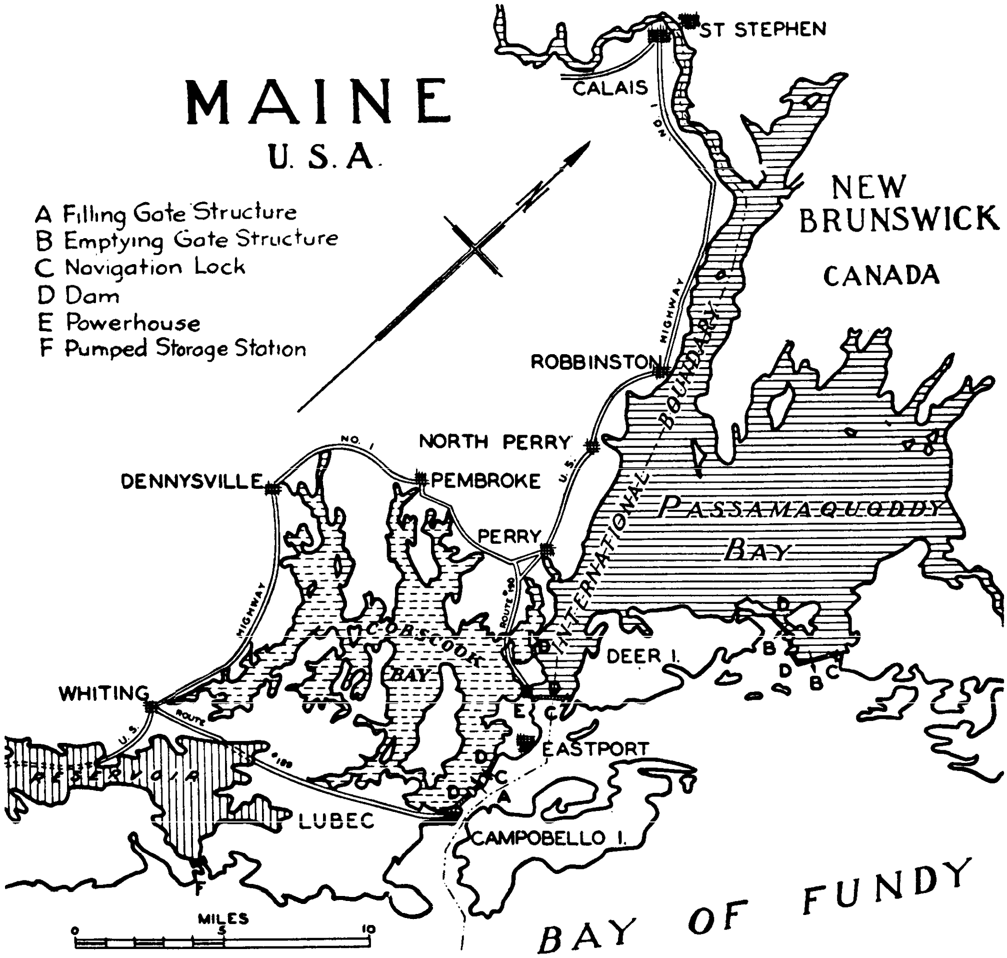


FIG. 1

The project authorized in 1935 was for the construction of only one step of the two-basin plan. It provided for the development only of Cobscook Bay, a 37 sq. mile (at high tide) estuary lying entirely in American waters. (Passamaquoddy Bay lies in Canada and its ultimate inclusion in a two-basin development will require the cooperation of Canada.) The plan of operation was to drain Cobscook Bay to low tide levels and when the outer tide rose some 5 1/2 feet higher than the interior tailwater basin level, to open the power house, generating power on the rising tide to high tide level and on the falling tide until the head was reduced again to near 5 1/2 feet. The power house would then be shut down due to insufficient head. As the tide fell further to the level of the interior basin, the gates would be opened and the "tailwater" in the basin permitted to drain to near low tide levels and the cycle resumed.

Whereas the two-basin development would provide some constant power, the single-basin development would require supplemental priming means to develop any firm power. For of the 12 hr. and 25 min. tidal cycle, power could be produced in varying amounts for periods of approximately 7 1/4 hours only. Cooper proposed a pumped storage reservoir at Haycock Harbor, about 16 miles distant, where surplus electric energy produced at and near high tide would be stored in the form of potential hydraulic energy by pumping sea water up into the artificially created high-head storage reservoir, to be drawn on for regeneration during shut-down periods at the tidal station.

CONCRETE PROBLEM

Under this program, as originally contemplated, providing 30,000 KW firm output and including a 10-unit 150,000 KW power station, with navigation lock, a commensurate gate structure and a large pumped storage development, a total of approximately 800,000 cu. yd. of concrete would have been required. This concrete would have been subject in varying degree to severe treatment from salt water action, intense freezing and extensive alternate wetting and drying. The quantities and conditions were such as to warrant an extensive concrete research program.

MODIFIED PROJECT

Our engineering investigations, including thorough foundation investigations, soils mechanics studies, model tests of turbines, scroll cases and draft tubes, complete hydraulic and power studies, and detailed designs and estimates, indicated the necessity of a material revision upward of the cost estimates of the project's initial promoter. They also disclosed that a better and cheaper project could be attained by (1) development of Cobscook Bay as a high-level rather than low-level basin with reversed operation from that originally planned, and (2) elimination of the pumped storage feature, and substitution therefor, for primary power, of power interchange with existing utilities or the provision of a thermal or hydro-electric auxiliary stand-by plant. With these changes it was also found that an equivalent energy output to that contemplated in the initial development (30,000 KW prime) could be attained by a reduction in size of the main tidal power and gate structure installation. Our total concrete requirements were thereby reduced to approximately 260,000 cu. yd. Inasmuch as the extensive concrete research program had, however, already been initiated on the basis of the larger project, and inasmuch as it was felt that these studies would prove to be of general value to the Corps of Engineers, to the engineering profession and general public, the program was continued until curtailment of activity on the project due to the action of Congress in not authorizing the project and appropriating no additional funds for its continuation. Certain phases of this investigation including maintenance and periodic inspection of 43 different concrete test columns now exposed at Eastport to salt water action at half tide elevation will, however, be continued indefinitely.

The conditions affecting Quoddy concrete are, as previously stated, most severe. Initially, this concrete is subject to salt water action, commonly recognized as injurious to normal concrete; secondly, due to the extreme tidal range existing at Eastport including a mean range slightly in excess of 18 ft. with maximum range approaching 27 ft., a large area of concrete is exposed to alternate wetting and drying twice each lunar day (24 hrs. 50 min.). Water under varying pressure is thus forced into the pores of the concrete at high tides and subsequently exposed at low tide to atmospheric effects; thirdly, due to the latitude at Eastport, concrete is subject to severe freezing temperatures.

BASIC ESSENTIALS

It must be recognized initially that there is no single panacea or cure-all for these conditions. It was not expected that some special cement or admixture or process would be found or developed which of itself would ensure a perfect concrete resistant to all these conditions.

The simple elements of the problem are generally as follows: A dense and impermeable masonry mass must be formed of durable stone and sand aggregates strongly cemented together, with the mass and its constituents unaffected by the physical changes resulting from heat and cold and from wetting and drying or by the chemical attack of salt water.

This dictates first that the *physical* structure of the concrete be sound and free from honeycombing, pores or tiny fissures which would furnish incipient "paths of deterioration" from freezing or incurrence of salt water. This requires: (a) selection of sound, dense, clean and well-graded coarse and fine aggregates; (b) limitation of water content to the minimum required for proper workability, as any water over and above that necessary for the hydration of the cement will leave pores corresponding to the physical space occupied by the water prior to its evaporation; (c) rigid control of mixing and placing, including vibration, to ensure a uniform mix of dense compaction, without segregation, of the concrete; (d) choice of a cement subject to minimum physical change in expansion or contraction in the process of setting. Inasmuch as the rate and extent of expansion and contraction are functions not only of the size of pour but also of the chemical composition and fineness of the cement, which affect its heat of hydration, control must be exercised over these features to prevent temperature cracks and fissures; (e) protection of the setting concrete by proper curing, including controlled cooling and protection from severe cold, to avoid insofar as possible excessive temperature changes within the mass, particularly during the early period when tensile and compressive strengths are still low.

The next major requirement is to ensure that the dense and impermeable masonry mass previously defined is protected from *chemical* disintegration. For this purpose, (a) aggregate must be sound and durable and not subject to disintegration from the chemical attack of sea water, and (b) similarly, but of even more importance, the cement, the critical binding agent in the mass, must be immune insofar as possible from chemical disintegration caused mainly by volumetric deformation in the formation of chemical combinations of certain elements in the cement with others, such as sodium and magnesium sulphate, commonly found in sea water.

To ensure that the concrete will be protected against physical change and destruction from freezing, (a) it must first of all be made dense and impermeable initially as previously stated, and (b) its constituents should have as low and uniform a coefficient of expansion as possible in order to avoid excessive differential temperature stresses.

Above all, however, it must be stressed that rigid and unending control of" the mixing, placing and curing of the concrete on the job are of importance equal to if not even greater than that of the determination and selection of the most suitable ingredients and mixture best adapted to resist severe climatic conditions and salt water attack. Much has been written on the importance of this or that element in cements or concrete mixtures but perhaps not enough on the importance of rigid field control in the concreting operation itself.

It is therefore to be stressed that the following discussion of the experimental program of cement and concrete tests recently conducted on the Quoddy project is offered not in any sense as a final solution to the problem of evolving a concrete resistant to cold weather and salt water but merely as an indication of the effects or tendencies of certain elements or conditions on such concrete. It is offered as a complement of and not a substitute for close field control of mixing, placing and curing.

An extensive and well equipped laboratory was set up at Eastport, as a subdivision of the Engineering Division, for the work under the immediate charge of Charles E. Wuerpel, Associate Engineer, who performed a splendid task in the organization of the laboratory and in the conduct of the experimental program. The laboratory was equipped with every facility for the testing of aggregates, cements and concretes.

AGGREGATES

Since stone or gravel and sand forming as they do the great bulk of any concrete are most important elements of good concrete, it was necessary to determine sources of suitable material obtainable locally if possible, in order to avoid high freight charges on the large tonnages required. Fifty-four sources of stone, gravel and sand were located and investigated. The most favorable sources of excellent appearing aggregates available at moderate haul were subjected to the usual laboratory analysis for grading, freedom from silt, specific gravity, porosity as evidenced by per cent absorption, soundness as evidenced by the magnesium sulphate test, and resistance to freezing and thawing. Sands were also subject to the standard tensile and compressive tests by comparison of mortars made of standard Ottawa Sand with others made of the sands to be tested.

An excellent sand in quantity (125,000 cu. yd.) more than adequate for the requirements of the initial project was found in an esker at Dennysville. The extent and consistency of this formation were determined by deep test pits excavated in the formation. Much of the gravel could also be obtained there, (70,000 cu. yd. incident to procuring the sand), the remainder of the coarse aggregate to be crushed stone from diabase formations at the site of the project.

Prior to finding the required amount of suitable sand, study was made of the possibility of producing a manufactured sand of fine crushed stone. Such stone dust produced a concrete of even greater compressive strength than that with Dennysville sand (which in turn gave better results than standard Ottawa) but required for approximately equal workability about 1/2 bag of cement more per cubic yard of concrete. Because of the lack of workability and tendency to produce a more porous though stronger mortar or concrete, it is not recommended.

As will be discussed later under the cement and concrete studies, the aggregates from these sources were found to be resistant to freezing and sulphate action; and in proper gradation and with suitable cement made an excellent concrete well suited to its conditions of exposure. To ensure absolutely the provision of suitable aggregate throughout the work, it was our plan, if operations had gone ahead, to install a screening and washing plant at Dennysville and a crushing and screening plant at Treat Island and to furnish to all contractors on the project their aggregate requirements. On a very large construction project such as Quoddy, with a number of different contractors, such procedure is considered essential to excellent concrete.

CEMENT

It was not our plan in the limited time available, to develop a new cement but rather to test the many standard cements commercially available. These cements extend over a wide range of physical and chemical characteristics. Some 45 cements were received and analysed, many of them with almost identical characteristics. They may be classed, however, as portland cements, high early strength portland cements, alumina cement, portland-puzzolan, synthetic puzzolan, natural cement, and blended cements.

CEMENT CHARACTERISTICS

The cements were subject to the routine tests for composition, fineness, soundness, consistency, time of set, and tensile and compressive strength (Table 1). There was close relationship between the increase in mortar compressive strength at 28 days with fineness of grinding for a number of portland cements of otherwise comparable characteristics (Fig. 2).

SALT WATER FOR MIXING

Studies were made of the effect of the use of salt water for mixing purposes on the compressive strength of cement mortar. (Fig. 3). Although increasing concentrations of sea water accelerate setting as compared to fresh water, such action is generally attained at the expense of ultimate strength and durability and is therefore to be condemned. Furthermore, concrete formed by salt solutions is less resistant to freezing and thawing action. It seems almost axiomatic therefore that only fresh water should be employed for mixing concrete.

HEAT OF HYDRATION

The heat of hydration is an important characteristic of the various types of cement. The effects of important elements affecting the heat of hydration are well illustrated in Table 2.

TABLE 2—CONTRIBUTION OF EACH PER CENT OF COMPOUND COMPOSITION TO HEAT OF HYDRATION IN CALORIES PER GRAM

Element	Age 2 Days	7 Days	28 Days
C_3S	1.0	1.14	1.25
C^2S	0.0	0.21	0.42
C_3A	1.5	2.44	2.32
C_4AF	0.4	0.20	0.11
Spec. Surf.*	2.0	2.20	2.00

*For each 100 cm^2/gm. over 1200 cm^2/gm. specific surface multiply by the factors shown for contribution to heat of hydration. These factors apply to cements having a heat of hydration of about 100 calories per gram.

TABLE 1—OXIDE ANALYSIS AND COMPOUND COMPOSITION OF TEST CEMENTS (SEE TABLE 1A)

Serial No.	Brand	Compound omposition				O: le Analysis							Insol. Res.	Free CaO	Sp. Grav. Cement
		C_3S	C_2S	C_3A	C_4AF	SiO_2	CaO	Fe_2O_3	Al_2O_3	MgO	SO_3	gn. Loss			
PC- 1	C	50	22	5.6	15.2	20.7	63.1	5.0	5.3	2.2	1.8	1.6	0.3	0.8	3.16
PC- 2	B	61	16	1.0	16.7	21.7	65.8	5.5	3.9	0.9	1.5	1.0	0.2	1.0	3.18
PC- 4	A	48	29	6.5	10.3	22.9	64.9	3.4	4.6	1.6	1.8	0.9	0.3	0.7	3.15
PC- 5	B	50	28	7.5	10.4	22.6	65.0	3.4	5.1	1.3	1.6	0.7	0.7	0.4	3.16
PC- 6	B	51	26	7.4	10.4	22.6	65.7	3.4	5.0	1.5	1.7	0.8	0.2	0.5	3.17
PC- 7	C	46	26	5.8	12.2	20.8	62.9	5.0	5.4	2.4	1.8	1.9	0.3	1.1	3.15
PC- 11	B	48	29	6.6	10.4	22.8	64.8	3.4	4.7	1.5	1.6	0.8	0.3	0.4	3.15
PC- 14	A	53	24	6.1	10.8	22.3	65.3	3.6	4.6	1.5	1.7	1.1	0.3	0.8	3.15
PC- 15	B	51	27	6.4	10.4	22.8	65.2	3.4	4.6	1.3	1.6	0.7	0.2	0.3	3.18
PC- 16	A	52	24	8.2	10.4	22.0	65.2	3.4	5.3	2.6	1.3	0.9	0.2	0.5	3.16
PC- 17	C	40	33	11.7	7.6	22.2	64.4	2.5	6.0	2.0	1.7	1.3	0.2	1.3	3.09
PC- 18	D	45	26	10.2	8.4	20.8	62.6	2.8	5.6	3.1	2.4	2.0	0.3	0.9	3.08
PC- 19	D	42	30	11.4	8.4	21.4	63.4	2.8	6.1	3.1	2.1	1.3	0.2	.07	3.11
PC- 20	B	50	24	9.3	8.5	21.3	64.2	2.8	5.3	3.1	2.0	1.2	0.2	0.9	3.09
PC- 21	D	43	26	15.2	7.3	20.3	63.3	2.4	7.3	3.3	1.9	1.2	0.2	0.9	3.11
PC- 22	A	50	20	14.4	7.8	19.9	63.8	2.6	7.1	3.4	1.9	1.6	0.2	0.5	3.09
PC- 23	E	50	19	14.7	7.9	19.8	64.7	2.6	7.2	3.0	1.6	1.0	0.1	1.6	3.10
PC- 24	H		Aluminous			8.7	38.0	14.3	39.2	1.5	0.3	0.0	1.1	0.0	3.19
PC- 25	F		Portland—Puzzolan			31.2	47.4	3.3	6.2	4.0	2.0	5.4	16.2	2.8	2.93
PC- 26	E	55	13	5.8	17.7	19.0	63.6	5.9	3.9	2.7	1.9	1.0	0.2	1.5	3.17
PC- 27	B	66	8	7.2	9.7	20.2	66.1	3.2	4.8	1.4	2.4	1.7	0.3	1.3	3.10
PC- 29	B	57	12	13.8	7.5	19.0	64.4	2.5	6.8	3.4	2.5	1.2	0.2	1.3	3.09
PC- 31	E	73	1	10.0	7.0	19.6	66.6	2.3	5.2	2.6	2.4	1.6	0.2	1.0	3.07
PC- 32	I		Natural			27.1	31.7	2.3	4.6	18.7	2.4	10.4	16.1	0.1	2.89
PC- 33	G		Synthetic Puzzolana			48.1	2.3	11.2	34.9	0.6	0.9	2.4	85.2	0.2	2.54
PC- 35	B	48	29	7.9	10.4	22.5	65.5	3.4	5.2	1.4	2.0	0.7	0.2	0.6	3.15
PC- 37	D	45	28	6.5	11.1	21.6	62.6	3.7	4.8	3.6	1.8	0.7	0.2	1.0	3.16
PC- 44	J	62	10	5.7	12.6	19.9	64.3	4.2	5.8	2.0	2.3	1.5	0.2	1.1	3.08
PC- 45	J	49	27	2.3	15.6	22.2	63.5	5.1	4.2	2.0	1.7	0.9	0.2	0.4	3.08
PC-100	ABC	53	23	4.6	14.1	21.8	64.6	4.6	4.7	1.6	1.7	1.1	0.6	0.8	3.16
PC-101	ADE	50	20	14.8	7.6	21.0	63.8	2.6	6.6	3.3	1.9	1.7	0.2	1.0	3.10
PC-102	ABCI	(PC	:2 21%	PC-100 79%)		22.9	57.7	8.5	4.7	5.2	1.8	3.0	3.9	0.6	3.10
PC-103	ABCG	(PC	:3 15%	PC-100 85%)		25.7	55.3	5.6	9.1	1.5	1.6	1.3	13.3	0.7	3.06

TABLE 1A (see Table 1, opposite page)

CEMENT FINENESS AND PARTICLE SIZE DISTRIBUTION | TENSILE AND COMPRESSIVE STRENGTHS—CEMENT MORTAR

Serial No.	Fineness			Particle Size Distribution													Tensil Strength p.s.i.					Compressive Strength p.s.i.				
				Micron Sizes—% Passing																						
	200 Mesh	325 Mesh	Surf. A. cm²/gm	.5	10	15	20	25	30	35	40	45	50	55	60	1 Da	3 Da	7 Da.	28 Da.	0 Da	1 Da	3 Da.	7 Da.	28 Da	0 Da	80 Da.
PC- 1	94.2	87.2	1790	24	29	39	47	54	60	67	73	79	82	85	87	128	272	264	449	443	45	500	2200	3915	5630	5570
PC- 2	95.4	91.5	1800	22	28	40	49	59	65	72	78	83	88	90	91	135	343	435	471	453	565	1390	2940	4590	5920	6470
PC- 4	97.6	92.8	1810	24	30	40	49	59	64	73	78	83	88	91	93	140	318	402	425	479	275	2350	2925	4275	5840	6400
PC- 5	98.6	94.2	1750	21	26	38	49	60	67	73	79	85	89	93	95	133	267	371	458	475	120	1235	1950	3525	5310	6225
PC- 6	98.8	94.4	1790	21	27	40	51	62	68	75	81	87	92	93	94	140	258	348	413	461	235	1285	2000	4400	5800	6075
PC- 7	94.8	86.9	1830	24	30	39	47	55	58	67	73	78	83	85	87	158	257	365	438	458	100	2560	2990	4375	5170	5620
PC- 11	98.6	95.7	1810	22	26	38	48	55	62	71	78	85	88	94	96	190	290	341	428	432	430	1320	2675	4325	5740	5835
PC- 14	90.0	82.9	1550	19	24	35	43	49	54	60	65	72	75	79	83	98	183	313	410	466	165	1050	2325	3405	3015	5785
PC- 15	91.0	82.4	1460	14	24	37	46	52	57	63	70	73	79	80	82	100	218	343	389	471	90	720	1390	2655	4305	4735
PC- 16	91.6	83.2	1650	21	27	36	46	50	54	62	66	71	78	81	83	107	232	395	421	441	150	875	1810	3475	4895	5475
PC- 17	94.2	86.9	1820	24	30	37	47	54	62	67	71	76	80	83	87	122	317	358	445	482	200	1260	2575	4860	5930	....
PC- 18	98.4	95.0	2710	51	60	68	76	80	88	91	95	95	95	95	95	185	373	379	484	520	525	3040	4700	6415	6895	6920
PC- 19	86.0	78.0	1670	21	25	39	46	52	55	60	66	70	73	76	78	88	283	310	447	444	140	1325	2525	4275	5515	5935
PC- 20	99.4	95.8	2020	26	33	45	57	65	72	81	87	90	94	96	96	165	328	410	505	585	140	1700	3415	6085	6925	6970
PC- 21	88.0	79.2	1380	16	20	30	38	45	52	57	61	67	71	74	79	102	277	382	433	466	65	1100	2240	3950	4800	4825
PC- 22	94.2	86.8	1670	20	26	36	47	56	63	69	73	79	81	84	87	140	310	420	411	443	175	1275	2450	4210	5400	5435
PC- 23	89.4	79.5	1420	21	28	31	40	47	53	54	64	69	74	76	80	103	298	373	413	426	150	1085	2660	4085	4465	4385
PC- 24	80.0	70.0	1390	19	22	30	36	42	46	51	54	60	63	66	70	437	432	415	415	464	7200	8170	8440	8500	7450	7710
PC- 25	86.2	85.3	2490	40	45	53	58	65	70	74	77	79	82	82	85	120	245	300	404	448	100	650	1860	3160	3985	4765
PC- 26	90.4	82.9	1310	15	21	24	33	42	49	51	63	68	77	81	83	118	282	362	430	449	125	710	1990	3600	4405	4465
PC- 27	99.0	95.7	2270	31	38	51	61	70	77	83	87	91	93	96	96	277	417	453	505	509	1435	2950	4110	5060	6410	6225
PC- 29	98.8	94.9	2030	25	35	46	56	64	72	77	85	89	93	95	95	275	338	398	515	525	690	2625	4825	6440	6650	6810
PC- 31	95.6	92.2	1950	25	32	44	54	62	69	74	80	83	88	90	92	325	408	437	484	488	1150	2565	4045	6160	6590	6625
PC- 32	90.8	86.6	2370	37	44	56	65	72	75	78	82	84	84	87	87	0	65	150	196	250	0	75	175	865	1455	1760
PC- 33	94.1	91.9	1530	14	23	40	53	63	69	76	81	84	88	90	92											
PC- 35	92.6	85.2	1715	22	27	36	45	53	59	65	70	78	80	83	85	150	255	357	384	475	475	1680	2840	4250	5140	5210
PC- 37	93.6	88.6	1980	26	31	41	50	58	64	69	76	80	85	87	89	173	317	368	453	469[1]	767	2000	3450	5467	6160	6800
PC- 44	99.6	98.2	2650	38	46	60	74	82	88	92	95	93	95	98	98	333	410	460	475	475	1460	3933	5525	6485	6750	6725[2]
PC- 45	95.0	88.2	1840	25	30	40	48	56	63	70	76	79	82	87	88	208	310	364	453	484	175	1700	2810	4310	5000	5370[2]
PC-100	95.8	90.5	1890													143	303	385	452	472	175	1425	2370	4485	5890	6150
PC-101	90.5	81.8	1490													115	263	265	419	443	75	1700	2350	4285	5265	5175
PC-102	94.7	89.7	1960													124	265	364	424	447	50	975	1960	3840	4740	5215
PC-103	95.6	90.7	1800													118	266	350	436	489	42	1215	2165	4240	5585	6940

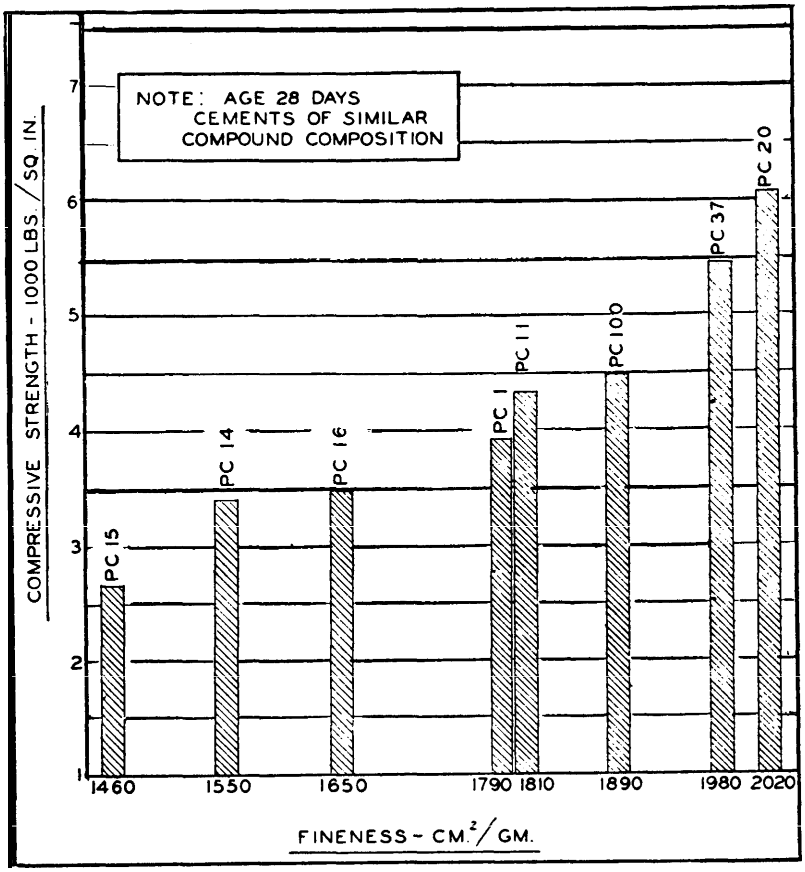


FIG. 2—EFFECT OF CEMENT FINENESS ON COMPRESSIVE STRENGTH OF MORTAR

The great effects on heat of hydration in the important initial period of setting of (a) fineness of grinding, (b) the tricalcium silicates (C^3S) and (c) the tricalcium-aluminates (C^3A) are readily apparent. These indicate the need of a balancing of these factors in the selection of the cement, as well as a close control of heat dissipation in mass and semi-mass concretes if excessive stresses, occuring during a period when the strength of the concrete has not been fully developed, with resultant cracking and incipient failure through disintegration, are to be avoided.

MAGNESIUM SULPHATE

The cement must be resistant to the chemical action of sea water. It is not possible in a short period to test the resistance of cements and concrete to sea water itself although such tests are underway with concrete columns now exposed at Eastport and will be continued). It is possible, however, to determine analogously the relative resistance of cements to sea water attack by the standard accelerated magnesium

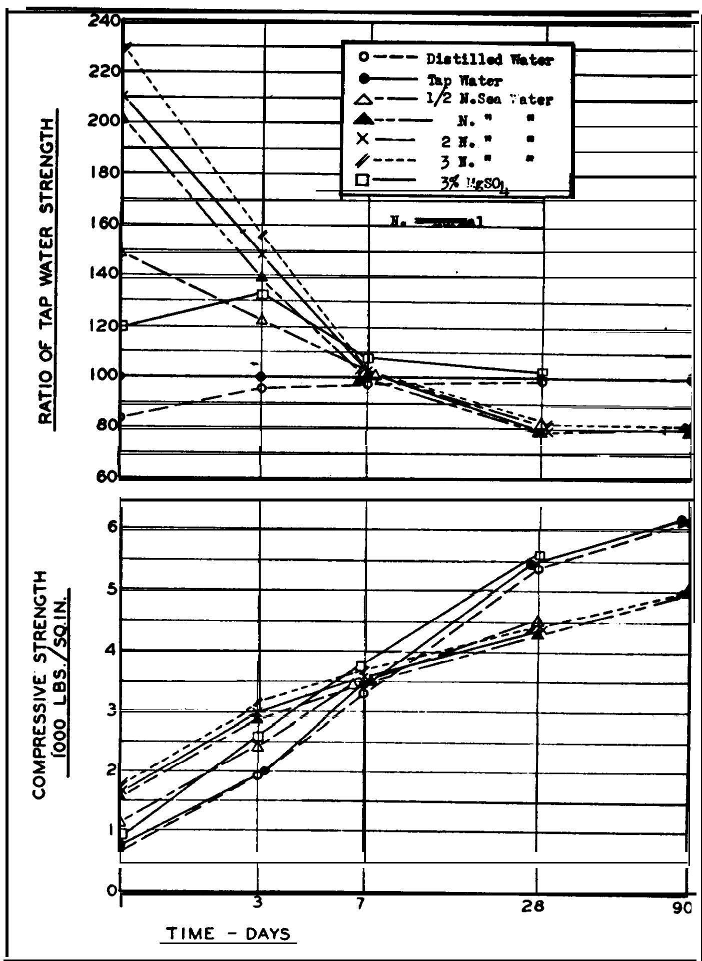


FIG. 3—EFFECT OF MIXING WATER UPON COMPRESSIVE STRENGTH OF CEMENT MORTAR (PC-37)

sulphate test by immersion of neat cement slabs in 10 per cent magnesium sulphate solutions for 280 days. Our tests (Table 3) in general confirmed the findings of other investigators that those cements high in C_3A had slight resistance to the magnesium sulphate attack and hence are not adapted to salt water use. However, the aluminous cement, which attains such high strengths in relatively short time, shows itself absolutely resistant to the magnesium sulphate action.

Our magnesium sulphate tests indicated very definitely the desirability of limiting the C_3A compound in portland cements to less than 8 per cent for proper resistance to salt water action.

BLEEDING

A concrete, including of course its cement binding paste, must be resistant to "bleeding," the expression used to designate the tendency of particles in the paste to settle so that only a film of water remains

TABLE 3—QUALITATIVE COMPARISON OF RESISTANCE OF CEMENTS TO ATTACK BY MAGNESIUM SULPHATE

Cement No.	Compounds				Fineness cm^2/gm	Date Immersed	Age Days	Degree of Attack	Age Days	Degree of Attack
	C_3S	C_2S	C_3A	C_4AF						
PC- 1	50	22	5.6	15.2	1790	10-31-35	104	Slight	280	Slight
PC- 2	61	16	1.0	16.7	1800	11- 8-35	96	Slight	280	Slight
PC- 4	48	29	6.5	10.3	1810	10-25-35	110	Slight	280	Slight
PC- 5	50	28	7.5	10.4	1750	10-25-35	110	Slight	280	Slight
PC- 6	51	26	7.4	10.4	1790	10-29-35	106	Slight	280	Moderate
PC- 7	46	26	5.8	15.2	1830	10-29-35	106	Slight	280	Moderate
PC-11	48	29	6.6	10.4	1810	10-25-35	110	Slight	280	Slight
PC-14	53	24	6.1	10.8	1350	10-25-35	110	Slight	280	Slight
PC-15	51	27	6.4	10.4	1460	10-25-35	110	Slight	280	Slight
PC-16	52	24	8.2	10.4	1650	10-29-35	106	Slight	280	Slight
PC-17	40	33	11.7	7.6	1820	10-31-35	104	Moderate	280	Moderate
PC-18	45	26	10.2	8.4	2710	10-31-35	104	Moderate	280	100% Disint.
PC-19	42	30	11.4	8.4	1670	10-31-35	104	100% Disint.*	280	100% Disint.*
PC-20	50	24	9.3	8.5	2020	11-14-35	90	Slight	280	Slight
PC-21	43	26	15.2	7.3	1380	11- 8-35	96	Serious	280	100% Disint.*
PC-22	50	20	14.4	7.8	1670	10-25-35	110	100% Disint.*	280	100% Disint.*
PC-23	50	19	14.7	7.9	1420	10-25-35	110	Slight	280	Moderate
PC-24		Aluminous			1390	10-25-35	110	None	280	None
PC-25		Portland Puzzolan			2490	10-25-35	110	Slight	280	Slight
PC-26	55	13	5.8	17.7	1310	10-25-35	110	Slight	280	Slight
PC-27	66	8	7.2	9.7	2270	10-29-35	106	Slight	280	Slight
PC-29	57	12	13.8	7.5	2030	10-31-35	104	Moderate	280	100% Disint.*
PC-31	73	1	10.0	7.0	1950	10-25-35	110	Slight	280	Slight
PC-37	45	28	6.5	11.1	1980	4-14-36	118	None	...	....
PC-44	62	10	5.7	12.6	2650	4-14-36	118	Very Slight	...	....
PC-45	49	27	2.3	15.6	1840	4-16-36	116	Very Slight	...	....

*Completely disintegrated.

at the surface to bind the underside of overlying aggregate particles. As this water film evaporates, a tiny void area on the under surface of the aggregate particles remains, resulting not only in a weaker concrete but one permitting the access of water with resultant danger from freezing, etc. (Reference is made to the photomicrograph illustration, Fig. 4, of certain concrete slabs which were divided by the concrete saw employed in the laboratory and then polished.)

Tests for bleeding were made of 18 of the cements with pastes of various water-cement ratios ranging from 0.7 to 1.0 (with the apparatus shown in Fig. 5). Our tests indicated generally that high specific surface area or fineness, particularly in particles finer than the 7.5 micron size tended to reduce the bleeding effect.

Here again, however, it is desired to stress that the use of a cement of reduced bleeding characteristics, resistance to magnesium sulphate attack, etc., will not eliminate in any manner the need for close field control in the matter of low water content, excellent grading of aggregates and mix, rate of placing, and manner of placing and compaction. The cement factor is complementary to but no substitute for close field control.

TEST RESULTS ON TYPICAL CEMENTS

It is of course impossible within the limitations of this paper to list all or even a major part of the test results. The following tabulation summarizes the tests made on some of the cements which may be considered typical of the following classes:

Cement		C_3S	C_3A	Fineness
Portland	A (PC-100) (PC-37)	normal $\mp$ 50%	med. to low (8 to 1%)	med. high $\mp$ 1900 $\frac{cm^2}{g}$
	B (PC-101)	normal $\mp$ 50%	high (10 to 15%)	med. $\mp$ 1500 $\frac{cm^2}{g}$
High-Early Strength	C (PC-27) (PC-31)	normal to high (45 to 73%)	med. to high 5.7 to 13.8%)	high (1950 to 2710 $\frac{cm^2}{g}$)
Natural	(PC-32)			high 2370 $\frac{cm^2}{g}$
Aluminous	(PC-24)	(not calculable)		med.-low 1390 $\frac{cm^2}{g}$
Portland-Puzzolan	(PC-25) (PC-103)			high 2490 $\frac{cm^2}{g}$ 1800
Portland-natural blend	(PC-102)	(79% PC-100 + 21% PC-32)		1960 $\frac{cm^2}{g}$

The tabulation of test data* shows the various cement classes, the chemical analysis and compound composition, sieve analysis, fineness,

*The author's Table 4 will be of considerable interest to some readers. It is in 18 typewritten pages. Copies will be supplied to members of the Institute at the cost of reproduction by whatever process is suited to the evident demand.—EDITOR

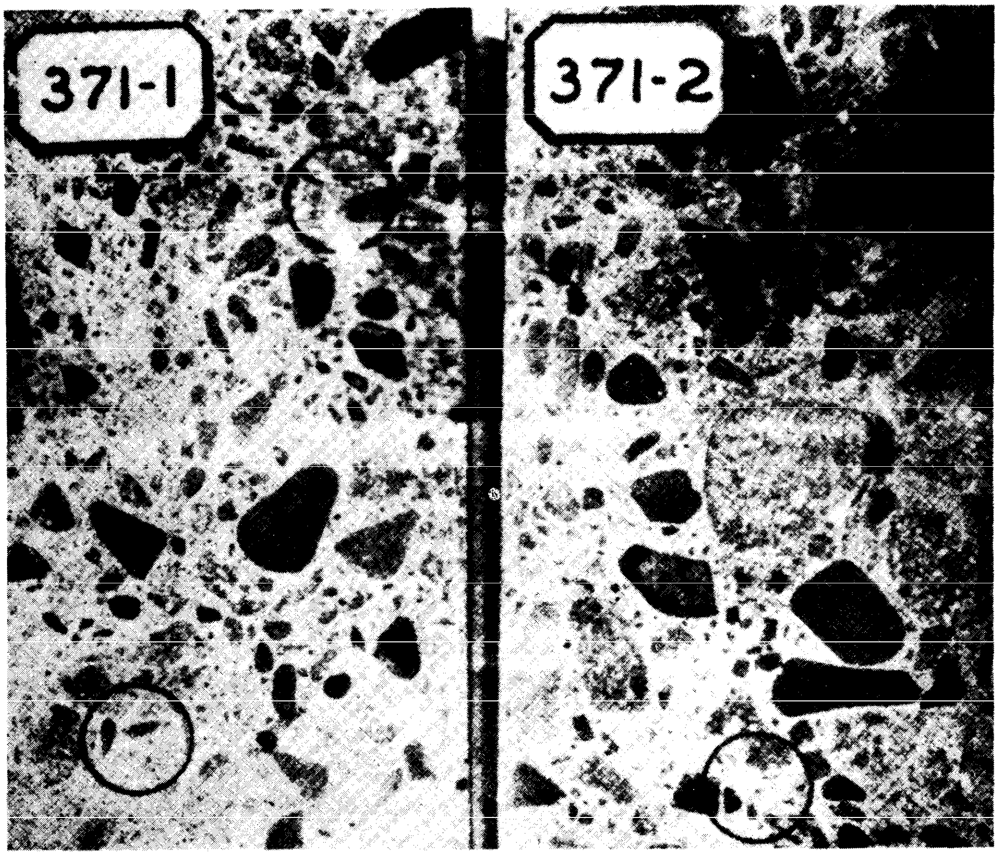


FIG. 4—CONCRETE SLABS MARKED AND READY FOR DRILLING CORES (SEE FIG. 4A)

resistance to magnesium sulphate action, volumetric change of plastic mortar during curing, under alternate wetting and drying and under alternating freezing and thawing, thermal coefficient of expansion, compressive strength under varying curing conditions, tensile strength of standard mortar, and, for concrete made with this cement, volumetric changes under different curing conditions and under alternating freezing and thawing, the coefficient of thermal expansion and compressive strength.

In general, the tabulation of test results shows that the portland cements of the A type (medium high fineness and low C^3A) attain excellent strengths in reasonably short periods and are resistant to magnesium sulphate attack and to material volume change under both alternate wetting and drying and freezing and thawing.

The portland cement Type B (medium fineness and high C^3A), though showing satisfactory strengths, could not withstand the sulphate attack nor the volume change resulting from alternate freezing and thawing conditions.

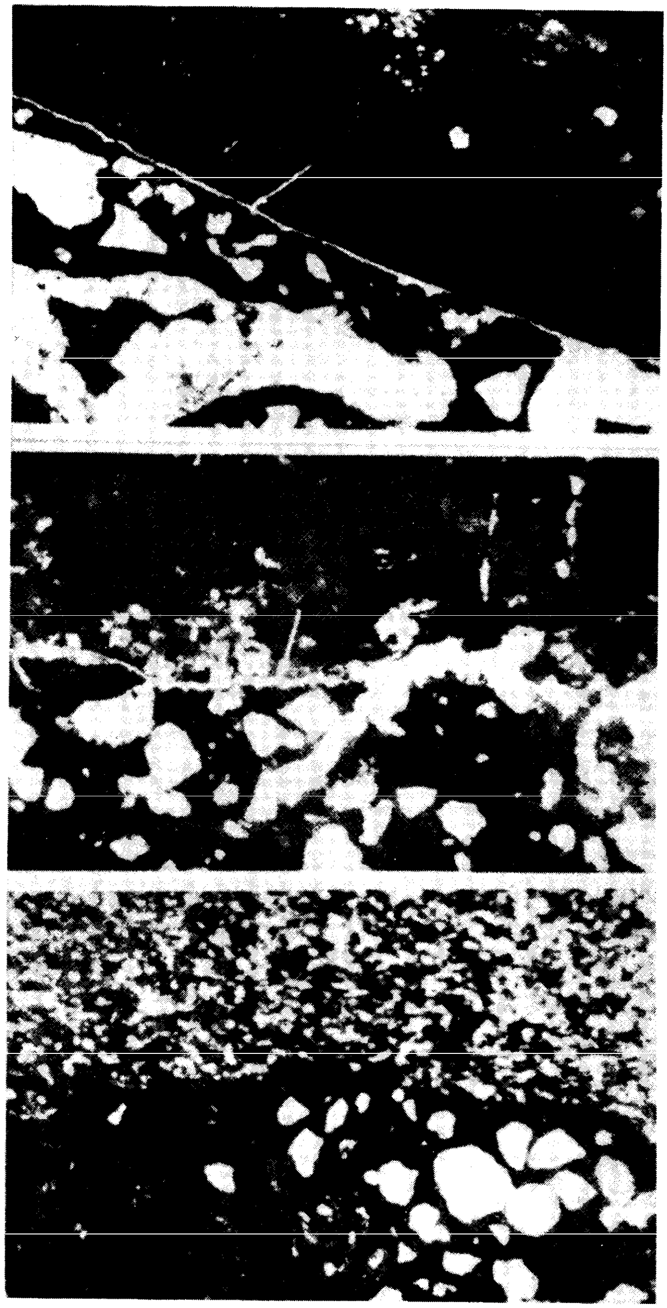


FIG. 4A—PHOTOMICROGRAPHS OF UNDER SIDES OF AGGREGATE PARTICLES SHOWING FILMS OF WATER-GAIN DUE TO BLEEDING OF CEMENTS

Top.—Normal cement; water-cement ratio, 9.90
Center.—Normal cement; water-cement ratio, 0.80
Bottom.—Non-bleeding cement; water-cement ratio, 0.90

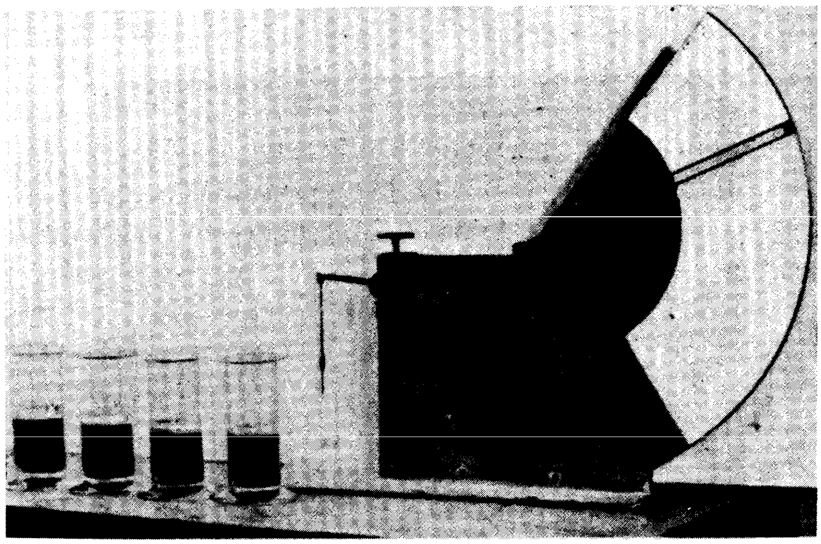


FIG. 5—BLEEDING TEST APPARATUS

The high early strength cements gave, of course, excellent strength characteristics, showed themselves but slightly affected by the magnesium sulphate attack, and resisted well the alternating wetting and drying and freezing and thawing. In mass concrete, however, there would be a problem in the dissipation of the heat of hydration.

The natural cement showed its great weakness in its slow rate of setting and in low strengths attained.

The aluminous cement gave an excellent performance throughout. It showed maximum strengths at very early stages and was absolutely resistant to sulphate attack, as well as giving an excellent performance in resistance to volumetric change from alternate wetting and drying and freezing and thawing. It showed also a low thermal coefficient of expansion. In mass concrete, there would of course be a problem in the dissipation of heat in the setting.

The portland-puzzolan cement showed reasonable strengths, gave high resistance to magnesium sulphate attack, but performed poorly under alternate freezing and thawing.

The blend of portland and natural cements showed moderate strengths, but showed poor resistance to alternating conditions of freezing and thawing.

OPTIMUM MIXTURE

The concrete studies were extended to determine for the various available aggregates the optimum mixture. This determination is most important for any major concrete structure if a dense impermeable and long-lived concrete is to be attained. It should be carried out continuously not only prior to but during the entire concreting operation in order to make such changes as are currently indicated with change in aggregate, etc. Our studies were based on concrete to be placed by internal vibration at a rate of +3800 r.p.m., requiring a slump of about 1 1/2 in. Such determinations do not of course represent the optimum for other methods of placement.

The average grading of fine aggregate employed (closely controlled) was as follows:

Sieve No.	4	8	16	28	48	100
% Passing	100	71.7	50.5	29.2	12.8	4.9

A coarse aggregate also carefully graded with maximum size of 2 in., (because of the extensive amount of closely spaced reinforcement) was also employed.

Tabulations were made of various combinations of sizes of the major coarse aggregates considered showing unit weights and voids, together with the optimum mixtures as obtained from over 150 trial batches (Tables 5 and 6).

To test density obtained—discs (3/4 in. through) were sawed from the top, bottom and center of various 6 x 6 x 12-in. specimens of optimum mixes and tested for absorption, specific gravity and voids (Table 7).

When one considers that 7 1/2 per cent of the voids occur from the excess water required for proper workability, but which fails to enter into combination with the cement, it is seen that air voids in the mix are reduced to approximately one per cent. And only by such close control can a durable concrete be obtained.

VOLUMETRIC CHANGE

Inasmuch as data on the volumetric change of concrete in setting and under extreme ranges of heat ‘transfer including freezing, are of great importance in concrete design, an extensive series of tests relating to volumetric changes was performed on concrete beams of varying aggregates and cements. Corollary thereto and incident to the conversion of one to the other, tests were also run to determine, in addition to the compressive strength, the modulus of elasticity and of rupture, plastic flow, thermal coefficient of expansion, diffusion constant, thermal conductivity and specific heat. Tests were run also to determine the volumetric changes caused by changed moisture conditions.

A description of these tests and discussion of their results should form the basis of a separate paper and are too extensive to be included in the scope of this article. However, some of the principal results which are of general interest are summarized.

TABLE 5—UNIT WEIGHTS AND VOIDS—COARSE AGGREGATE (COMBINED SIZES)

Material	Coarse Aggregate Ratio			Dry Weights, lbs. per cu. ft.						Per cent Voids (by Sp. Gr.)		
	No. 1	No. 2	No. 3	Loose		Rodded		Vibrated		Loose	Rodded	Vibrated
	¼" — ⅜"	⅜"— 1"	1" — 2"	% Sand	Weight	% Sand	Weight	% Sand	Weight	Same Sand Content as in Previous Three Columns		
Dennysville Gravel	33.33	66.67	..	....	97.50	....	111.00	....	117.00	41.2	33.1	29.5
"	41.67	58.33	..	....	97.75	....	111.25	....	114.25	41.1	33.0	31.2
"	20	40	40	....	108.75	....	114.00	....	118.25	34.5	31.3	28.8
"	25	35	40	....	109.50	....	116.25	....	119.50	34.0	30.0	28.0
" +Denn. Sand	20	40	40	....	.....	27.1	128.50	27.1	137.50	....	22.4	17.1
" "	25	35	40	....	.....	28.5	131.25	28.5	140.25	....	20.8	15.5
Shackford Diabase	33.33	66.67	..	....	92.50	....	103.75	....	111.00	48.1	41.9	37.8
"	41.67	58.33	..	....	92.00	....	103.50	....	110.50	48.5	42.0	38.1
"	20	40	40	....	95.50	....	109.25	....	116.00	46.5	38.8	35.0
"	25	35	40	....	96.50	....	112.00	....	116.25	46.0	37.2	34.9
" +Denn. Sand	20	40	40	25.2	114.50	25.2	131.50	28.6	138.00	34.6	25.0	21.0
" +Denn. Sand	25	35	40	26.1	113.00	23.4	126.25	27.4	133.75	35.4	28.0	23.4
Black H. Diabase	33.33	66.67	..	....	89.75	....	101.75	....	109.50	50.4	43.8	39.5
"	41.67	58.33	..	....	90.25	....	102.50	....	109.62	50.2	43.4	39.4
"	20	40	40	....	94.75	....	108.00	....	115.75	47.6	40.3	36.0
"	25	35	40	....	95.25	....	109.00	....	114.25	47.4	39.8	36.9
" +Denn. Sand	20	40	40	27.2	117.75	24.3	133.00	27.0	137.25	33.3	25.0	22.2
" +Denn. Sand	25	35	40	25.6	114.50	25.6	127.00	27.3	134.50	35.1	28.2	23.8
Devil's H. Granite	33.33	66.67	..	....	83.25	....	92.73	....	99.25	48.0	42.0	37.9
"	41.67	58.33	..	....	81.50	....	92.50	....	100.00	49.0	42.1	37.4
"	20	40	40	....	88.25	....	98.62	....	104.00	44.8	38.3	34.9
"	25	35	40	....	89.50	....	99.25	....	104.75	44.0	37.9	34.5
" +Denn. Sand	20	40	40	30.4	108.50	26.9	123.00	30.3	127.00	32.8	23.8	20.9
" +Denn. Sand	25	35	40	30.5	104.75	28.2	118.73	31.2	124.25	35.2	26.4	23.1

Dennysville Gravel = Natural Dennysville Gravel
Denn. Sand = Natural Dennysville Sand
Shackford Diabase = Crushed Shackford Head Diabase
Black H. Diabase = Crushed Black Head Diabase
Devil's H. Granite = Crushed Devil's Head Granite.

TABLE 6—OPTIMUM MIXTURES OF CONCRETE

Cement Factor Sx/c.y.	Coarse Aggregate		Max. Sixe	Sand No.	Cement No.	Proportions by Weight	Grad.* of C. A.	W/C gal./sx.	Sand Agg. Ratio	Slump In.	Remolding Effect Seconds to		
	Serial No.										1.0″	0.5″	0″
5.00	G-4	Dennysville Gravel	2″	S.26	PC-37	1-2.30-4.95	A	6.00	32%	1½	7	8	10
5.25	R-3	Shackford	2″	S-26	PC-37	1-2.31-4.84	B	6.00	34	1½	7	12	20
5.25	R-16	Black Head	2″	S-26	PC-37	1-2.31-4.91	B	6.00	34	1	10	18	30
5.25	R-23	Devil's Head	2″	S-26	PC-35B	1-2.31-4.34	B	6.00	34	1¼	9	19	31
6.00	G-4	Dennysville Gravel	1″	S-26	PC-37	1-2.02-3.77	H	5.50	35	3	7	9	11
6.60	R-3	Shackford	1″	S-26	PC-37	1-1.81-3.49	H	5.50	36	1¼	14	18	24

*Grading	Size No. 1 ¼″—⅜″	Size No. 2 ¾″—1″	Size No. 3 1″—2″
A	20%	40%	40%
B	25	35	40
H	35	65	

TABLE 7—ABSORPTION, SPECIFIC GRAVITY AND VOIDS IN CONCRETE*

Coarse Aggregate	Group	App. Spec. Grav.	Abs. Sepc. Grav.	Absorption	Voids
Shackford	V-1-B	2.488	2.702	3.18%	7.92%
"	V-1-C	2.481	2.709	3.38%	8.41%
"	V-2-A	2.439	2.685	3.76%	9.16%
"	V-2-B	2.438	2.681	3.71%	9.06%
"	V-2-C	2.439	2.680	3.68%	9.00%
Dennysville	V-3-A	2.414	2.636	3.495%	8.42%
"	V-3-B	2.380	2.608	3.675%	8.74%
"	V-3-C	2.377	2.613	3.79%	9.03%
"	V-4-A	2.404	2.607	3.24%	7.78%
"	V-4-B	2.385	2.597	3.42%	8.16%
"	V-4-C	2.370	2.586	3.51%	8.35%
Average: Shackford	V-1 & V-2	2.461	2.693	3.500%	8.617%
Average: Dennysville	V-3 & V-4	2.388	2.608	3.520%	8.415%

*Optimum mixture for each aggregate—PC-37 cement.

Modulus of Elasticity

For similar concrete mixes with the portland cement type A (PC-37) and w/c = 0.8, the modulus of elasticity varied at 28 days from 3,650,000 p.s.i. for Devil's Head (granite) coarse aggregate to 5,550,000 p.s.i. with Schackford Head (diabase) aggregate with Dennysville gravel showing 4,800,000 p.s.i. These factors increased with the age of the concrete (about 25 per cent at 180 days).

Plastic Flow

Plastic flow coefficients ranged for otherwise similar optimum concrete mixes w/c = .8, under a constant load of 400 p.s.i. for 130 days from .000185 for Devil's Head granite as aggregate to .000305 for Dennysville gravel. Flow had not, however, ceased at this time when the tests had to be terminated.

Thermal Coefficient of Expansion

For similar mixes these factors ranged per degree Fahrenheit from .000004 for concrete with Schackford Head diabase to .0000045 for concrete with Devil's Head granite, just above that with Dennysville gravel at .00000445. (The coefficient for steel averages about 50 per cent higher and shows how excessive stresses may be set up between the concrete and reinforcement under wide temperature ranges.) With similar coarse aggregates (Dennysville gravel) and different cements the coefficient ranged from .00000445 (with PC-100) to .0000051 (with PC-103.) Furthermore, it was observed that those concretes with high coefficients of expansion generally showed earlier signs of failure under successive cycles of freezing and thawing.

Freezing and Thawing

Consistent with the foregoing, it was observed that the volume change, as measured by the ratio of length expansion to total length, of concrete beams under 200 and more freezing and thawing cycles varied to some degree with the same cement (PC-100) and different coarse aggregates from .00001 in. per in. to .00015 in. per in. With similar aggregate (Dennysville gravel) these coefficients ranged from .00015 with PC-100 cement to a range of .00044 to .00051 in. per in. for other cements (PC-25, 102 and 103) and to failure with one cement (PC-101). (Fig. 6).

Volume Change by Moisture Changes

With the same cement (PC-100) and different coarse aggregates the changes in length under alternate wetting and drying were generally similar whereas slightly greater changes occurred with similar coarse aggregates but different cements.

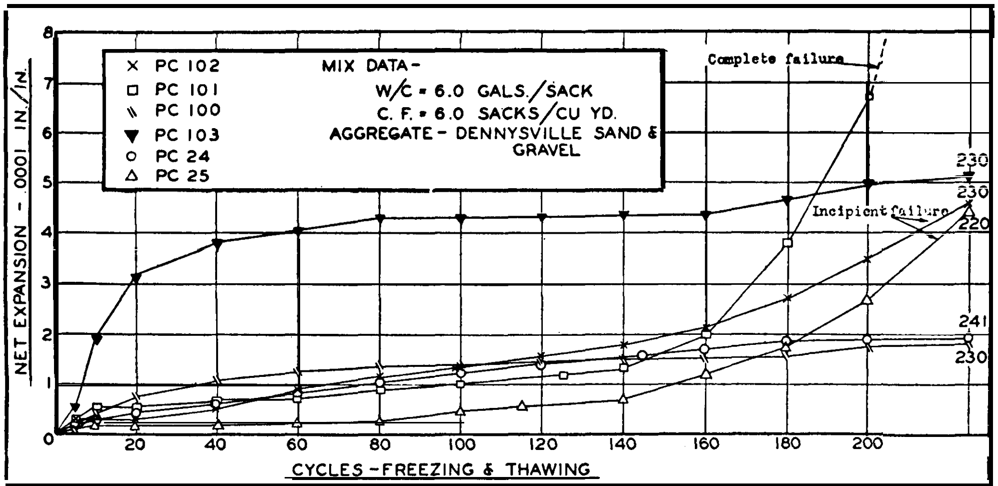


FIG. 6—FREEZING AND THAWING EFFECT OF CEMENT TYPE UPON VOLUME MOVEMENT OF 3 x 3 x 12 IN. CONCRETE BEAMS

For concrete prisms 12 x 12 x 36 in. to 48 in hermetically sealed except at one or both ends, average shrinkage ranged at 140 to 180 days from about .00027 in. per in. at 1/2 in. depth from the exposed end, to about .00008 in. per in. at 60 days and thereafter at 2.5 in. depth, to negligible shrinkage at 12 in. depth or greater. Comparative tests to determine the effect of steel reinforcement on the drying shrinkage of concrete were initiated but could not be brought to completion. However, these tests, extended over 80 days, indicated but little change at equal depths between reinforced and non-reinforced concrete. These tests do exemplify, however, in addition to the differences in shrinkage resulting from the use of various types of aggregates and cements, the great shrinkage which occurs during setting in the outer rim of any concrete pour, particularly if curing is neglected. Excessive tensile stresses are thereby set up during the early setting period, when the concrete is weak, in this critical outer section. In place of being the most important outer armor of protection, it thus becomes the Achilles heel or vulnerable zone for possible future destruction or disintegration of the entire mass through its tiny fissures and cracks, permitting the entry of water, salt, frost and other destructive agents.

Flexural Strenglh

For similar mixes flexural strength ranged as follows for corresponding coarse aggregate: For Devil's Head granite 417 p.s.i., Blackhead diabase 580 p.s.i., Dennysville gravel, 605, and Schackford Head diabase 625 p.s.i.

Thermal Flow

An extensive study of thermal flow in concrete was also undertaken by E. A. Wilder, Junior Engineer, Assistant in the Concrete Laboratory. This included a study of average temperatures to be encountered annually, to determine the number of freezing cycles together with a study of tidal cycles to determine the varying periods to which various elevations of the concrete would be subject to alternate wetting, drying and freezing. Thus with data as to air and water temperatures and convection factors and data on conductivity, specific heat, density, uncombined moisture and coefficient of surface cooling of the concrete, it is possible to determine the areas subject to alternate freezing and thawing.

Mr. Wilder evolved, in addition to other formulae on heat flow, the following formulae on the assumption that no heat is gained by conduction from the interior and that the heat liberated by freezing of uncombined moisture is equal to the net amount of heat lost by conduction in the same time interval:

For freezing:

$$t = \frac{144\,\mu\,\rho}{(28.3 - b)\,ak}\left(\frac{ax^2}{2} + kx\right)$$

For thawing:

$$t = \frac{144\,\mu\,\rho}{(b - 28.3)\,ak}\left(\frac{ax^2}{2} + kx\right)$$

t = time in hours

b = air or water temperature to which exposed (For example, air = 28° F. water = 40° F.)

a = convection factor air = 2 BTU/□c/hr./ F. water = 260 BTU/□c/hr./ F.

Freezing point of sea water = 28.3° F.

k = conductivity factor concrete (example = 1.07 BTU/ft./hr./°F.)

ρ = density concrete (example 158.9 lb./cu. ft.)

μ = uncombined moisture (example 4%)

x = depth of freezing in feet

For concrete subject to tidal action, the maximum freezing under assumed constant temperature conditions occurs where the concrete frozen in t hrs. is thawed in 12.4—t hrs. (the 12.4 being the hours in a tidal cycle).

Substituting t and 12.4—t in the equations and solving show for the data assumed in this tide cycle a depth of freezing of 2.1 inch occurring at a point exposed 11.23 hrs. and covered 1.17 hrs. Formulae were also evolved to determine the rate and extent of heat flow in concrete.

Thermal Properties

The thermal properties of concrete made with different coarse aggregate were determined (Table 8).

TABLE 8—THERMAL PROPERTIES OF CONCRETE AT 70° F.

Coarse Aggregate	Conductivity "k" BTU/ft./hr./°F.	Specific Heat "C" BTU/lb./°F.	Density "ρ" BTU/lb./°F.	Coefficient of Diffusion "h^2" sq. ft./hr.	Coefficient of Surface Cooling "S"
Dennysville Gravel	1.30	0.23	152.8	0.037	0.148
Devils Head Granite	1.24	0.23	149.4	0.036	0.153
Black Head Diabase Treat Island Diabase	1.06	0.23	158.9	0.029	0.161
Shackford Head Diabase	1.01	0.23	157.5	0.028	0.165

Notes: Specific heat, density, and coefficient of diffusion were determined for Class B concrete (Water-Cement Ratio = 6.0 gal. per sack. Maximum size of coarse aggregate = 2-inches) The conductivity and the coefficient of surface cooling were computed from the other thermal properties. $\left(h^2 = \frac{k}{C\rho}\right)$

CURING

In connection with the actual field placing of the concrete too much stress cannot be placed on the subject of proper curing. Irrespective of the care taken in selection of aggregates, method of mixing and placing, etc., incipient failure and limited life to the concrete may result from faulty curing.

SALT WATER CURING

Due to the expense and possible shortage of fresh water and the availability of sea water at Eastport, study was made of the use of salt water for curing purposes. No damaging effects were observed. On the contrary a comparison of 46 tests based on 28-day cylinders showed an average of 4340 p.s.i. compressive strength for cylinders cured 28 days in salt water at 70° F. as compared to 4169 p.s.i. for concrete cured in the most room 14 days at 70° F. It is most important, however, that the film of salt deposited on horizontal construction joints during curing be thoroughly cleaned off prior to concreting the next lift as otherwise a plane of weakness and future disintegration will occur.

CURING PROCEDURE FOR MASS AND SEMI-MASS CONCRETE

For the prevention or reduction of surface cracking from rapid cooling and drying, the following procedure for mass or semi-mass concrete is warranted. Initially, the cement should not have an excessive heat of hydration incident to too high fineness or specific surface area and high C^3S and C^3A content (against these must be balanced the advantages of early strength gain, a function of these factors, and bleeding, an inverse function of fineness); secondly, the size of pour and of monoliths should be limited; thirdly, ingredients entering the concrete should be kept at a reasonably low temperature (50° F.); fourthly, to avoid excessive tensile stresses at periods when the concrete has not developed strength adequate to withstand them, forms of adequate insulating value should be kept on sufficiently long and in freezing weather such supplemental protection afforded as to assure a gradual and fairly uniform heat reduction; fifthly, maintenance of the concrete at near 50° F. for a period of about 3 days after removal of forms with a gradual reduction therefrom in winter; sixthly, to ensure against cracking from early drying of the surface concrete, the concrete should be kept saturated not only while the forms are in place but also after their removal for a total period of 14 days if possible.

For salt water concrete even greater than normal protection in the amount of concrete' coverage outside of the steel reinforcement is warranted (minimum of 6 in. if possible) to ensure that the steel rein. forcement is not subject to salt water attack which might occur through the incursion of salt water through tiny surface pores or checks.

TYPE OF CEMENT PROPOSED

As a result of the various tests performed at Quoddy and review of literature on the subject, it was decided to employ a portland cement generally as specified under A. S. T. M. designation C77-32, modified as follows:

Chemical composition:		
Upper limits	Loss on ignition	3.0 per cent
	Insoluble residue	0.65
	Sulphuric Anhydride (SO^3)	2.00
	Magnesia (MgO)	5.00

Ratio: Iron to alumina $\frac{Fe^2O^3}{Al^2O^3}$ = not more than 1.56
not less than 0.50

Silica (S^1O^2) not less than 21 per cent

Compound composition (R. H. Bogue method) Tricalcium silicate (C^3S) not more than 55 per cent
not less than 40 per cent
Tricalcium aluminate (C^3A) not more than 8 per cent

Fineness: not less than 1800 sq. cm. per gram
not more than 2300 sq. cm. per gram
(Wagner turbidimeter, ASTM, C115-34T)

The cement as above specified (conforming generally to the PC-100 or PC-37 as used in the tests) is considered well suited for the semi-mass concrete exposed to the conditions obtaining on the Quoddy project. It can be developed at moderate cost at every standard portland cement mill in the country. It has no radical innovations or cure-alls. It has a good service record. It makes a concrete resistant to sulphate action, to material volumetric changes occurring from setting or moisture or heat changes, and to alternate freezing and thawing; it attains a reasonably early strength without excessive heat of hydration.

But above all, it is not expected that its use will permit the reduction by one iota of the other equally important ingredients of good durable concrete; namely, closely controlled grading, mixing, placing and curing.

The writer was chief engineer of the engineering division of the project. Charles E. Wuerpel, Associate Engineer, was in immediate charge of the concrete laboratory and tests. Lt. Col. Philip B. Fleming, Corps of Engineers, was District Engineer in local charge of the project. Brig. General George R. Spalding served as Division Engineer, North Atlantic Division, in supervisory charge. Major General E. M. Markham, Chief of Engineers, is the responsible head of this and all other river and harbor and flood control projects under the Army Engineers throughout the country.

Discussion of the foregoing paper will be welcome if received in triplicate by the Secretary of the Institute by April 1, 1937. For such discussion as may develop readers are referred to the JOURNAL *for May-June, 1957.*

Appendix F
“Memo to: Deputy Chief of Staff”

COPY*

22 January 1942.

Memo to: Deputy Chief of Staff,
(Thru ACS - GS)

1. It is appreciated that a decision having been issued should be executed. It is urged however that serious consideration be given to the possibility of review of the estimate of situation which dictated the directive to move our forces back to occupy the reserve battle position by Jan 26th.

2. Estimates indicate that the enemy force opposing our present position is not large and greatly inferior to ours in total strength. The unit commanders in the front feel they can hold their present position. Morale is high in most units. The enemy situation on the west has been cleared up in the rear and under control in the front. The present front, tho longer than that of the reserve battle position, is stronger, better wired and organized than the rear position. The artillery positions and field of fire are stated to be superior for the forward position. The Bagac 8 guns now being installed will be lost if we move back to the RBP. Pilar airfield will be lost and Bataan Field subject to long range artillery. The lateral communication available to us on the Pilar-Bagac road for lateral movement of forces for counterattack will no longer be available. By withdrawal we shall lose our wire communications, barbed wire as well as the fertile Balanga area.

3. The concentration of our entire force in a small area will increase enemy serial concentration and losses as compared to dispersed targets over the present enlarge occupied area.

4. Virtually nothing has been done in the way of organization of the west sector of the RBP. It is jungle country, difficult for emplacement of units, organization, communication and defense. Field of fire is limited.

5. Enemy activity in the center has been exaggerated in virtually all reports received. It consists to a great degree of strong enemy patrols and snipers, which

*Note: This document has been retyped but retains the spelling, punctuation, and style of the original. The original is in the Research Collections of the Office of History, Headquarters, U.S. Army Corps of Engineers, Hugh J. Casey Papers, Folder 9.

if met by properly organized and trained sniping groups can be controlled without fear of forward elements being cut off and surrounded. Such enemy groups will have a difficult supply problem in replenishment of foot, ammunition, etc. and should be readily handled. Conversely enemy supply will be simplified.

6. It is felt that an organized reserve force maintained as a trained unit to meet and clear such enemy detachments as will continuously break thru the heavily wooded areas of either position, which would be withdrawn and reconstituted as a mobile reserve immediately after each such encounter could handle our principal present enemy operations.

7. The withdrawal of our entire long range artillery will make the present position difficult to hold, subjecting it to unharassed enemy artillery. If the slow moving long range artillery is to be evacuated with a view to ultimate withdrawal, some guns should still be left forward if our forward position is held, (for destruction, if they cannot be moved, as we have 155 MM guns in excess of requirements or possible emplacement in the small rear area of Bataan).

8. Our principal requirement is to hold for TIME until reinforcements come. The longer we can delay the enemy on our present front, the more time we can save including our later defense of the RBP. The enemy should be force to pay dearly for every foot of advance to make his final effort more difficult with reduced forces. Above all it is hoped that history will not show that small enemy infiltration sniping patrols will have caused a mass withdrawal of our entire force at a time when we must continue to hold.

9. As General MacArthur indicated January 15 in his message to the command, "No further retreat is possible - - - - if we retreat we will be destroyed."

H. J. C.

Appendix G
“Inspection of MRL, Bataan”

HEADQUARTERS*
United States Army Forces in the Far East
Office of the Engineer
In the Field HJC/pn

8 March 1942.

Subject: Inspection of MLR, Bataan.

To: Commanding General, USAFFE

1. Between March 3 and March 6 accompanied by Major Gay, assistant, I made an inspection on foot of the entire line MLR position from the west to east coast of Bataan. The Corps Engr and his Asst as well as representatives of Subsector Commanders in the I Corps, and representatives of the 41st and 21st Divisions in the 11 Corps, as well as some of the Regimental Bn and most of the company and platoon commanders joined and accompanied us on the inspection over those reaches in their respective fronts.

2. In general the degree of improvement varied inversely with accessibility to the respective positions indicating that positions easily inspected by the higher commands were inspected and improved and stretches difficult of access had not been adequately inspected nor improved.

3. The positions organized by the U. S. Air Corps and by the 11 (h infantry were outstanding y excellent. Other positions were reasonably well prepared. On certain positions, the type and extent of improvement are inexcusable, considering the time available for their improvement. It is not intended for this report to criticize specific positions in which a number of defects occur as such defects were pointed out during the inspection. It is desired however to secure general corrective action on the following general deficiencies observed.

4. The following are general findings applicable to many positions.

*Note: This document has been retyped but retains the spelling, punctuation, and style of the original. The original is in the Research Collections of the Office of History, Headquarters, U.S. Army Corps of Engineers, Hugh J. Casey Papers, Folder 11.

A. Fire positions.

(1) In numerous cases, (at least 300 personally so observed) the foxholes or trenches with such shelter as is provided, are so constructed as to prevent the soldier from giving aimed fire to his front. Restricted clearance space below the overhead cover interfere to such a degree that the soldier, when sighting, can only aim and fire at an upward angle at and above tree tops to his front. If he fires at all, generally parallel to the ground to his front, he can do so only without aiming.

(2) This indicates two things: (a), that certain soldiers are concerned far more in their own cover protection during combat than in dealing effective fire on their enemy (which is actually their best protection in an attack) and (b) that platoon leaders, company commanders and other officers have not checked individual shelters and trenches with their troops in fire position to ensure the effectiveness of the preparation and defense of the position.

(3) Even in many cases where no overhead cover was provided and only open fire trenches or foxholes were utilized, numerous instances were noted where positions were constructed on downward sloping terrain and long parapets were constructed horizontally such that aimed fire could not be delivered parallel to the ground over which the enemy could advance but only above the heads of the enemy.

(4) In numerous other cases, long firing grooves were cut thru the parapet in a straight rather than flaring direction so that the soldier could fire only to cover a few yards of his front rather than targets to his right and left front as well.

B. Machine Gun Positions

(1) The principal basic errors with respect to machine guns consisted of

(a) Faulty location whereby plunging as compared to grazing fire was secured.

(b) Frontal rather than enfilading fire.

(c) Inability to secure aimed fire from a number of the positions.

(d) Lack of continued training in the operation of their weapon instructions and directives to MG personnel relative to their functions on final protective line, failure to provide definite steps to mark traverse limits or final protective line for night firing.

(e) Carelessness in the construction of the emplacement and failure to provide adequate mount foundation such that the machine gun (many of which had not been test fired at all on their present positions) would jar loose due to failure of its inadequate foundation, at the critical moment when it would be vitally needed.

(2) With respect to (a), there are many cases where the forward movement of a machine gun 10 to 50 yards would increase the effectiveness of the gun from 200 to 500 times. The importance of grazing as against plunging fire is apparently not fully appreciated. If the trajectory is parallel to the ground the bullet is effective over the entire 300 to 500 yd reach in front of the gun whereas when the gun fires from an elevation onto flat ground in front, the bullet is effective only over the few yards immediately adjacent to where it strikes. This is a most important factor in night firing where the enemy cannot be seen. Inasmuch as most attacks will occur at night, it seems vital that every effort should be made to secure grazing and effective fire, including giving greater priority and consideration thereto than to how readily a machine gun can be most easily evacuated. A machine gun well located will not need evacuation. A gun poorly located will have to be evacuated due to its ineffectiveness during attack.

(3) With respect to (b), insufficient effort has been made to get the best enfilading fire possible. In a number of cases all organizational machine guns are distributed generally uniformly over the front, firing (except for some small horizontal traverse) solely to the front. If these weapons were placed with respect to certain topographic features, bends in the front or in coordination with those of adjacent units so as to attain enfilading fire, a far greater and more effective coverage of the front could be secured – particularly so for night defense. If the trace of the barbed wire were varied more to conform to the bands of enfilading fire from such machine guns, delaying the enemy in passing thru such bands, an almost impassable position (until such guns are destroyed) is assured. Marked improvement in the defensive strength of certain positions can be so secured.

(4) With respect to (c), it was found that in some machine gun positions, the clearance to overhead cover was so restricted as to prevent delivery of aimed fire, even without a helmet. This was particularly the case in a number of instances where the gun had to be depressed to give grazing fire over downward slopes in front of the position. In other cases it was impossible to traverse the weapon with its rear sight up or to correct stoppages because of

inadequate vertical clearance. Because of the lack of a few inches of excavation or raising of head cover, and failure of adequate inspection, vital machine guns would be ineffective in combat.

(5) With respect to (d), it was found that a number of machine gunners are not adequately instructed and trained in their duties, with insufficient or no information on their "final protective line, " limits of fire, ranges to know points. Written or typed instructions and sketches should be furnished to each gun position showing sector of fire, protective line etc. and definite stops or marks established for critical limits. Closer supervised training appears desirable.

(6) With respect to (e), mount foundations should be checked preferably by test firing, to assure that guns will function when needed, including careful inspection of mount foundations to assure that foundations won't fail (as they would in several guns inspected) at the first firing. In some cases only an inch or so of clay, easily broken off, supported the rear tripod leg.

C. Location of trenches.

(1) Serious errors have been made in many cases in the location of the trenches with respect to the terrain and potential field of fire. In numerous cases, trenches are located as close as 5 to 20 yds behind the military crest, limiting the field over which men can fire to this short distance, with the major distance over which the enemy must approach left defiladed. Relocation of these trenches a short distance further forward (utilizing existing trenches for support trenches or for better shelter) will immeasurably increase the defensive strength of the position.

(2) In certain cases the enemy is permitted to come down the opposite slope, cross a stream, climb the near slope and get to within hand grenade distance of the trenches without coming under fire, a dangerous situation for any night attack. Relocation of the trenches to where this defiladed approach area would be under continuous fire would greatly strengthen the position and make it almost impossible to take under any determined defense.

(3) Officers responsible for the siting and construction of such defense positions should critically review present locations from in front of and also from within the actual or proposed trench positions and select and develop that position which they can visualize would be the most difficult to approach and take.

D. Coordination between Adjacent Units.

(1) From Corps, thru Divisions, Regts, Bns. down to Platoons there appears to be a lack of sufficient coordination and cooperation in connection with the mutual supporting action of adjacent units, insofar as the organization of the ground and disposition of units are concerned.

(2) Each unit commander should know and confer frequently with the corresponding adjacent unit commander with respect to coordinating their positions for best mutual support.

(3) There is a strong tendency particularly in the lower units, to be concerned solely with its own unit and front, without recourse to mutual supporting action of adjacent guns or units. In numerous cases unit commanders did not know and had not consulted with commanders of adjacent units. There are many cases where a unit can do its most effective defense by covering by enfilade fire the front of an adjacent unit rather than its own, securing similar coverage of its own front from the adjacent units. In some cases the defensive strength can be increased many fold by such action.

(4) It is recommended that closer coordination between units be effected to include the tie - in between I and II Corps on the Pantingan River, the closure of the gap between the 31st and 21st Divisions, as well as numerous smaller cases thruout the front.

E. Shortening of line.

(1) In a number of cases, the line appears to be unduly extended, requiring greater forces or a thinning of the line because of the tendency to follow back up river valleys, edges of recessed wood clearing, etc. rather than generally straight across such features. On the Pantingan River Valley for example, the line extends well back up the valley and back again whereas a shorter line (keeping present line as a support or reserve line) would release men for reserves, prevent an infiltration in force by the enemy to the unprotected corridor, and permit a stronger defense of the shorter line, leaving auxiliary positions (the present one plus additional lines constructed across the valley) for successive defense in depth against any strong penetration.

F. Reserves and development in depth.

(1) Greater effort should be made to provide more reserves and to develop the position in depth. The 41st Division is well organized insofar as this feature is concerned. Reserves can be made available by a shortening of the line, as above indicated, and by a thinning out of those portions of the front of great natural defensive strength. The distribution of men along the front appears almost uniform, in a continuously occupied trench line clear across the front. Not sufficient attention has been given to the organization of strong points, combat groups, etc. which by proper utilization of terrain features and without continuous occupation of the front, can by mutually supporting fire, cover adjacent unoccupied reaches. It is appreciate that in the jungle, the occupation must be relatively uniform and continuous but even there greater strength should be given to natural avenues of approach (ravines, trails etc.). However in open areas mutually supporting combat groups rather than continuous occupation should be employed.

(2) It seems important to again stress the urgent need of an elastic defense. The enemy by a concentration of strength and fire at a point of his choosing can force, at a price, a penetration of the position. Reserves must be available to eject him. If they are all on the line, they cannot be withdrawn. The greatest assurance of having the maximum strength where and when most critically needed is by assurance of a mobil and adequate reserve. It is felt that in both Corps, greater reserve (Bn, Regimental and Divisional) can be built up by better utilization of combat groups rather than continuous front line occupation.

(3) The positions for Bn and Regt Reserve lines should be built up (now generally underdeveloped or not provided) to provide auxiliary positions against any local infiltration.

G. Barbed Wire.

(1) Wire is in many cases located too close to the trenches or machine guns. It should generally be beyond hand grenade distance from the line protected. Greater care should be placed in its location with respect to automatic weapons so that a band of fire can be placed down and along its front, so that the enemy is subjected to enfilading fire while delayed in getting thru the wire.

(2) Stakes or pickets should be solidly emplaced so that the wire can not be readily pushed down or removed.

H. Clearing Field of Fire.

(1) Fields of fire should be cleared to attain the maximum possible range of aimed fire in front of the position. This does not mean however in the jungle or heavily wooded areas that every tree and all brush must be removed. Only that portion of the underbrush, lower branches, etc., as furnish concealment 5 to 6 feet above the ground should be removed, leaving the overhead cover untouched. If the entire belt is cleared of all trees, vegetation, etc., the enemy from the air can readily see the exact location of the position and more easily bomb and strafe or give aerial observation and more accurate fire direction to artillery fire against the position, with resultant greater casualties to our forces.

I. Communication Trenches.

(1) Greater effort should be placed on the construction of communication trenches to the position so that protected approaches are available for supply of rations, ammunition and replacements or reinforcements during an attack. A few hours of work now will save lives and the position later.

J. Sanitation and Health.

(1) Greater control is necessary on sanitation. A command with 10 to 25 percent sick is reduced in combat efficiency to an even greater degree.

(2) Latrines should be adequate in number (1 per squad for convenience where unit is spread out). Discipline should be improved to ensure that latrines are used, and that feces are covered and not exposed to flies. (A number of latrines were observed with thousands of flies in them, which could migrate between latrines and soldiers' food contributing to sickness). One unit's latrines were located in advance of the front line. Insufficient attention is given to boiling water. Many organizations reported they boiled their water but inquiry developed that this was to be done by the individual soldier rather than the organization. That is laziness or neglect on the part of the unit Commander. A Filipino who is thirsty is not going to start a fire, boil his water 20 minutes, wait for it to cool and then satisfy his thirst. All organizations, by company or platoon, should be provided boiled water from a central source to their men to assure that they will drink only safe water.

(3) Sickness varied from little to as much as 25 percent or more of a command dependent on location, type and health resistance of soldiers, and efficiency and energy of the commanders. In most of the units, it was reported that no quinine is being furnished, except to those actually sick with malaria. In view of the small bulk of quinine and relative ease of getting quantities in, and its vital importance in the prevention of malaria, it is not believed we should run out of quinine. It is recommended, if combat efficiency is to be kept up that quinine issues be resumed, particularly to units having present high malaria rates and that first priority be given to replenishing and keeping up adequate stocks.

(4) Few of the troops have blankets. Special effort should be made to provide them before the rainy season. In order to make something available, I have directed that the remaining burlap in Engr Supply Depot be used for blankets rather than for camouflage or sandbags.

K. Rations and Cigarettes.

(1) Some special measures appear desirable to make at least occasional special ration issues to the units and the American officer personnel with them. It would appear possible to make a special issue to some unit, even if only once each week or two, to give them a little pickup form their daily routine, rotating the units to which such issues are made. It would also be a welcome change to many to get a hash or part hash issue occasionally in place of canned fish each day. Special consideration should be given to interior front divisions which cannot supplement their ration by fresh fish or other items available to coast and rear units. There is no question but that there is a marked difference between rations issued and available to front line units, who are in probably greatest need of them, as compared to the Service Command and Ft. Mills units, a situation which occasions some dissatisfaction and loss of morale.

(2) There is a dire lack of cigarettes among the front line units. Soldiers will pounce upon any discarded cigarette stub for a single puff. There is, in time of war no difference between the physical needs of smokers as between front and rear echelon units, unless the need at the front is greater. It would appear only just to make an equal allocation insofar as issues and the privilege to purchase are concerned, between all officers and men, at the front, in the rear echelon and at Ft. Mills. Troops should not be in the position of paying 2 Pesos per package of cigarettes, and even then being unable to get them when those in rear can secure them in plenty at 10 centavos.

(3) It is recommended that a uniform quota be established of present available stocks for the entire command, in the interest of improving morale in our most important elements, the front line units.

L. General.

(1) It is not intended to convey the impression that everything is wrong as might be inferred from reading general deficiencies listed in the foregoing report. Much good work has been done, and the units, now better seasoned, are determined to hold. The deficiencies indicated are pointed out with suggested corrective action only in the hope and with the objective of improving to a far greater degree the defensive strength of our position. Much of the foregoing improvement is already under way as when these deficiencies were pointed out to the respective unit commanders or the representatives of higher echelons, immediate corrective instructions were issued.

(2) The accomplishment so readily and quickly attained dictated one final recommendation namely that higher commanders and their staffs execute frequent personal reconnaissances on foot of their respective positions, personally checking units, training, defensive organization, etc. and not rely solely on subordinate reports or inspections of next lower echelon CP's. Nothing takes that place of personal reconnaissance.

HUGH J. CASEY,
Brig General, U. S. A.
Engineer,

Appendix H
"Military Engineers in War"
The Military Engineer

Engineers Building a Temporary Bridge across a River in Bataan

The MILITARY ENGINEER

Vol. XXXV FEBRUARY, 1943 No. 208

Tanks are Massive, Requiring Heavy Bridges for Their Movement

Military Engineers in War

HUGH J. CASEY

Brigadier General, United States Army
Chief Engineer, Southwest Pacific Area

OUR Society publication is THE MILITARY ENGINEER. We members are Military Engineers or are interested in promoting the efficiency of the military engineering service. It seems appropriate at this time, in view of the thousands of Military Engineers now engaged in and continually joining our forces, to define and analyze the specifications for a Military Engineer and by critical introspection to X-ray ourselves to determine to what degree we meet these specifications.

As Engineers we accustom ourselves to ensuring and enforcing compliance with specifications and terms of any contract. It is essential, therefore, that we define and know that contract and do all humanly possible to meet its terms.

The characteristics and requirements for a Military Engineer given here are based on recent observations of our military engineering activities in the Philippines and in the Southwest Pacific Area. It is hoped that their enunciation may prove of some value to our Military Engineers already in the Service and the thousands of others who are joining our ranks.

Modern warfare is highly mechanized. It has placed even greater demands than ever on our Engineers. Engineers are required for the design, production, and upkeep of our tanks, planes, ordnance, and numerous other technical requirements of National Defense. Our planes are heavy and fast, requiring extensive airfields through all types of operations areas. Our tanks are massive, requiring heavy bridges for their movement. Our supply requirements run to astronomical totals, placing heavy demands on docks, railroads, roads, and all transportation arteries. A vast quantity of storage for these supplies is also needed. Shelter, water supply, and utilities must be furnished for our men and for hospitalization. Millions of copies of maps of all types must be produced and furnished to our military forces. The job of the Engineer is to provide all of these facilities *on time* with whatever limited forces, plant, and materials are available. To perform that task the Military Engineer must be an animal possessing the following general characteristics.

He must have ENERGY. He should have the ability to carry on continued hard physical effort, oftentimes with lack of sleep, and still remain mentally and physically active. He must have the ability to pick up quickly in relatively short periods of rest after a period of hard exhaustion. This means that our field engineers particularly, must be young, able to climb mountains and tramp through tropical swamp and jungle with heavy equipment, live in wet clothing, without exhaustion and undue lowering of resistance, and still carry on.

He must possess INITIATIVE. A Military Engineer without initiative can not perform his job. It is impossible for higher headquarters to assign to all lower echelons the many engineering tasks which must be performed. The Engineer in the field and on the job must be continually seeking out and executing those tasks essential to advance the whole show.

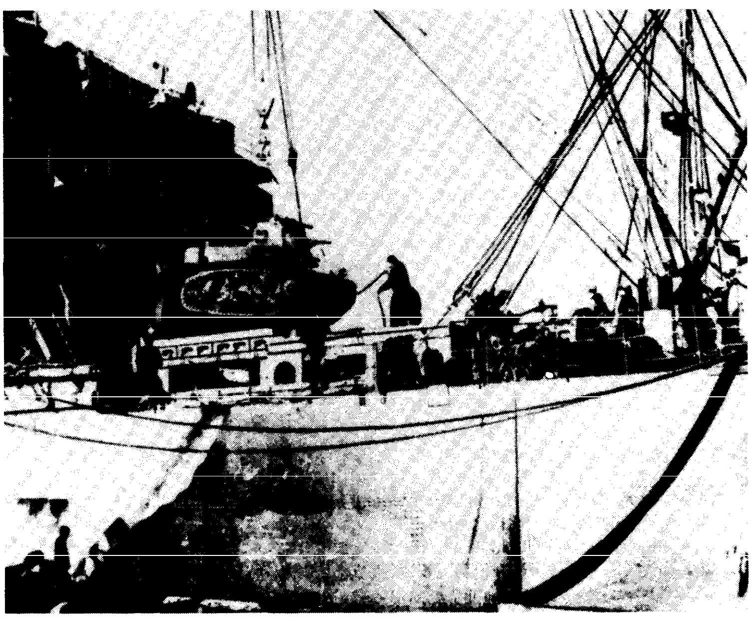
The Military Engineer should have IMAGINATION. This factor is very important. Our Engineer must have the ability to visualize a situation which has not yet happened, but which may occur, and out-line plans and measures necessary to meet it. He must be able to put himself in the position of those whom he and his unit are to assist. He must visualize their needs and requirements. He must be able on occasion to detach himself from himself sufficiently to review critically his own operations instructions, plans, and directions in order to ensure that they are what are needed and that they are understandable and clear to those to whom directed. Instructions issued which may initially appear perfectly clear to himself with his full background of information on the particular situation, may not be sufficiently complete and understandable to those to whom issued. He should, therefore, be able to put himself in the position of the other man and critically review his possibly incomplete opus to check if it will be clearly understood by the man to whom directed. He should, in any case, have sufficient imagination to visualize the numerous problems and difficulties which may and will arise, and check that appropriate planning or procurement measures are being taken to meet these contingencies.

He should have INTELLIGENCE. He should be capable of quickly grasping a situation and be alert in his mental processes and reactions to determine promptly a reasonable solution and measures necessary to handle the problem.

He should be capable of reducing any problem to its BASIC FUNDAMENTALS. Too often the average individual becomes so enmeshed with the mass of detail pertaining to any problem that he loses sight of the two, three, or four basic fundamentals of that problem. He should exercise great care to determine what these basic fundamentals are and to stick to them.

Field Engineers Must be Young and Physically Active

He should be capable of SEEING THE BIG PICTURE. As our Commander-in-Chief has so aptly put it, he should not lose sight of the forest for the trees. His perspective should be such as to ensure a proper balance of effort commensurate with the real importance of each task. On a construction job it is not enough to see that every man is busily engaged. He should constantly review that construction job to determine the bottle-neck which is the control on total output and concentrate his energy on opening up that bottle-neck control for greater production results. When that bottle-neck has been cleared, he should determine the next controlling factor and concentrate on it until it in turn is cleared if maximum production is to be attained.

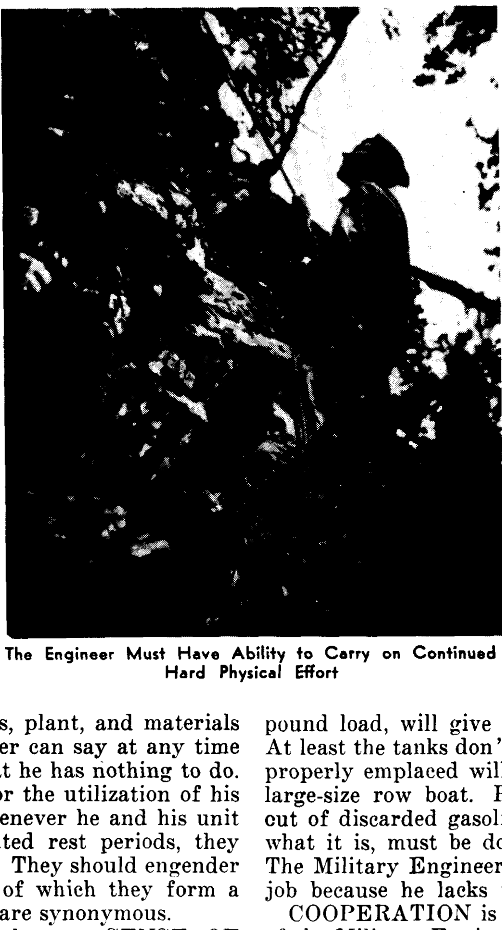


Supply Requirements Place Heavy Demands on Transportation Facilities

He should have a proper sense of BALANCE. He should not regard each man, problem, and piece of plant as a routine succession of items for equal consideration and treatment. He should appreciate, for example, that if a D-8 dozer can perform the output of 200 men, the care and nursing of that individual piece of plant merit a degree of consideration comparable to the thought applied to the care and handling of the equivalent 200 individuals, rather than as merely another single item to add to the 200 individual cases. Too often our engineers regard their plant, which, in the final analysis, may be the key to their productive capacity, as an inanimate something unworthy of their keen personal interest. A marked difference in production results will be noted between those units where balanced consideration is given to the varying importance of the individual problems which constantly prevail.

The Military Engineer must LOOK AFTER HIS MEN. He must defend them against all others. He must look after their wants and requirements. He should give them the praise that is their due. He should exercise special effort to get them such food, comforts, and whatnot as can be procured. He should let them know that they are the best working outfit in the forces, in which case they will strain themselves to merit the confidence placed in them and perform a job of which we shall all be proud. Men will take any degree of driving from their officers and leaders if they in turn know that they and their interests are being taken care of by those in their charge.

Our Engineers, in addition to their normal engineer functions, may also be engaged in COMBAT. They represent a strong potential combat reserve which has been and will be utilized in critical phases of the operations. The situation is always critical when a commander has to pull his Engineers from their normal engineer mission into combat. A Military Engineer must, therefore, ensure that his men have been given a sufficient degree of combat training to give his men a reasonable chance for their lives, wholly aside from the fact that such training may represent the difference between success and defeat or failure.


The Engineer Must Have Ability to Carry on Continued Hard Physical Effort

The Military Engineer must be able to WORK. Just as nothing beats fun, so nothing takes the place of work. I repeat, nothing takes the place of WORK. There is always far more to be done than can be done within the time, with the forces, plant, and materials available. No Military Engineer can say at any time during an all-out war effort that he has nothing to do. He should have plans on tap for the utilization of his men for many jobs ahead. Whenever he and his unit are seen, outside of their limited rest periods, they should be seen actively at work. They should engender the thought in the commands of which they form a part that Engineers and Work are synonymous.

A Military Engineer must have a SENSE OF HUMOR; otherwise he is likely to go mad. Blunders are going to be made, confusion will be met and untold difficulties will be encountered. A major league batter who makes three successful hits out of ten times at bat, not to count the strikes called against him, is considered an excellent performer and big-league caliber. Perfection in any human field is not attainable. Errors will be made. Impossible, unintelligible, and conflicting orders will occasionally be received. Tough situations will be encountered. In such situations, the Military Engineer must not lose his sense of humor. A joke or laugh in a tight spot may save the day. A message to the President: "Please send us a new P-40 as ours is full of holes," relieved the nervous strain and tension in a tight situation. Similarly, a message to the Governor of California from Bataan, when it was learned that an enemy submarine had shelled a small dot on the thousand miles of California coastline, urging them to hold on until the BBB's* could send him aid, gave some hard pressed boys a pickup when they needed it most. A Military Engineer taut with nervous tension under difficulty is unqualified to perform his task. Turn that hang-dog expression in for one of good cheer. It will help both you and your men.

A Military Engineer must have the ability to IMPROVISE. He will have to do his job with what is available on the spot. There is no corner hardware shop to get the supplies, or industrial establishment to turn out the tools that he needs for the job immediately ahead. He must do it with what is on hand. If hand grenades are not available, a cookie (most appetizing to serve) can be made from a piece of bamboo, a stick of dynamite, some nails, mud, a cap and fuse with cellophane-wrapped match attached. A larger cookie with a piece of automobile spring for a catapult or with a bow and arrow arrangement made of discarded inner tubes may make a workable even though less capable substitute for lacking mortars. In the absence of tank mines, a tiny wooden coffin with ten pounds of dynamite, an electric cap, a flashlight battery with contacts operated by crushing in the top, secured by only sufficient brads to sustain a 400-pound load, will give reasonably satisfactory results. At least the tanks don't like it. The use of boiler plate properly emplaced will make a small cruiser out of a large-size row boat. Piers and bridges can be built out of discarded gasoline drums. The job, no matter what it is, must be done with whatever is available. The Military Engineer will never say he can't do the job because he lacks the means.

COOPERATION is another essential characteristic of the Military Engineer. He must be ready in every way to help our troops advance or hold. He should never fail to do any job required merely because it is the responsibility of someone else, if that someone else is not there. If other service elements are not forward at the site, the engineers should take on the job within the relative priority of importance of the various tasks to be performed.

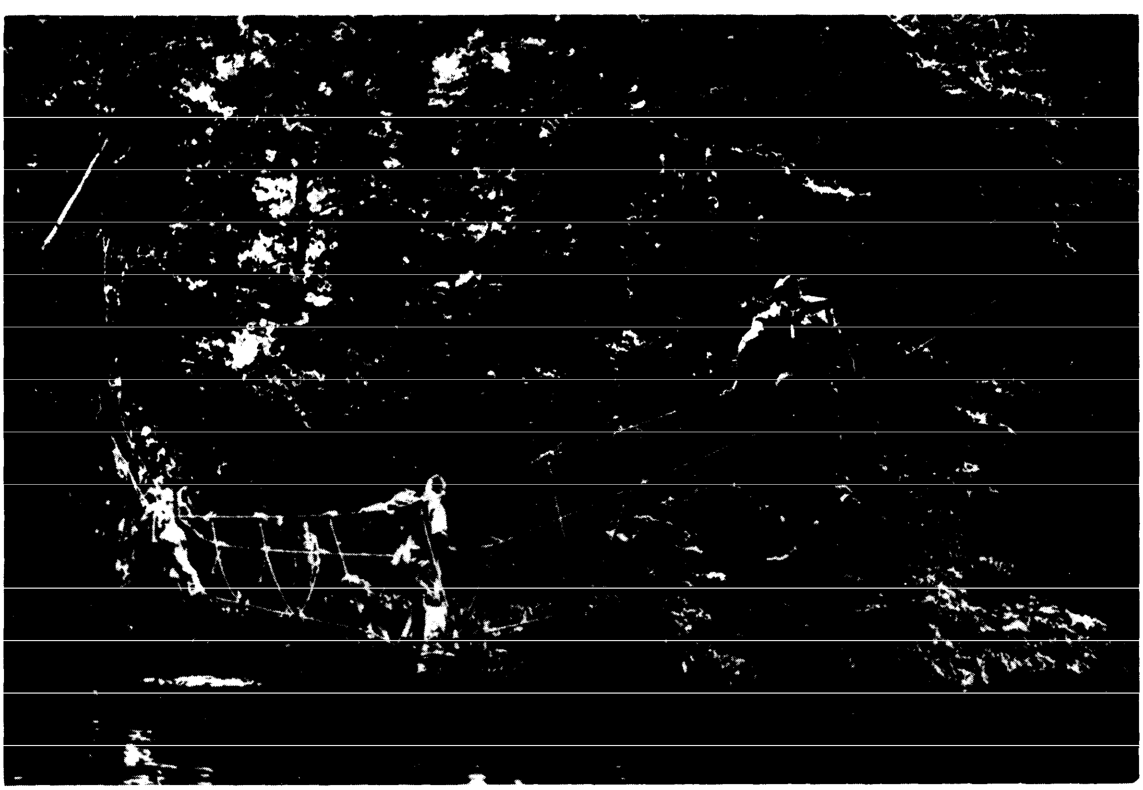
ADVANCE PLANNING is most important. A Mil-

*(Battling Bastards of Bataan.)

itary Engineer should never be caught with his "trousers drooping," (a more elegant expression for "pants down"). He should constantly be visualizing his future problems and requirements and making necessary provision therefor. His tools, plant, men, and materials should be provided or arranged for insofar as possible well in advance to ensure that they will be available at the point where needed, when needed. Relatively little effort expended on advance planning will save much effort and frantic confusion later in trying to procure the means which, if properly planned for in advance, would be already available. If these requirements have generally been adequately provided in advance, additional emergency needs will be relatively few and will actually receive more prompt and complete consideration with greater assurance of their being furnished than if they form part of a vast number being screeched for. The need for careful advance planning can not be overstressed.

The Military Engineer should be possessed of a reasonable degree of PROFESSIONAL OR TECHNICAL KNOWLEDGE. What is even more important, he should be currently and continuously improving himself in learning what he can from the various references and training literature available on the problems he is currently meeting. He should observe and profit not only from his own experience but also from that of others. He should exercise special pains to cull out the basic fundamentals of each subject rather than to overtax his mind with a vast accumulation of detail. He should, for example, with respect to the construction of a landing strip, appreciate that sufficient drainage must be provided around the island strip to prevent water entering the subgrade as well as to afford drainage relief to what water does get through. If, because of lack of drainage the subgrade to a landing strip is soup or mud, a surface layer of 6-inch steel would still sink and be incapable of supporting planes. He must also appreciate that a surface of such lateral strength must be provided as to distribute the 20-ton-per-square-foot impact of heavy bombers over such 10 or 20 square feet of area as would reduce the unit loading to one which the subgrade can support. As a final desirable element, a raincoat or seal coat which would prevent surface water from penetrating into the subgrade will further protect the strip from deterioration. These are the basic essentials which he should keep in mind. It is of course essential that he also know the limitations of slope and crown and degree of variation in longitudinal slope as dictated by the operating characteristics of our planes. In any case he should know where he can get this information in the limited reference texts that form his bible. Technical libraries are just out of reach.

His WORK SHOULD BE PLANNED. In the execution of the job he should make such quick preliminary investigations of soil, sources of materials, distance of haul, possible methods of construction, et cetera, as will ensure that the job will be done satisfactorily with a minimum of expenditure of time, labor, and plant. A source of material on a slope where a chinaman can be provided for quick gravity loading of trucks with material fed to the chinaman by a bulldozer will be far more effective than resorting to power shovel loading. A reasonable amount of effort given to the consideration and evaluation of the



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He Must Have Intelligence to Grasp a Situation and Handle it Promptly
Here is shown a method of destroying a bridge against the invader in Bataan. Straw was piled on the bridge and later set on fire.

various possible methods of construction, and determination of the most efficient method, will effect a great savings in time as well as in physical effort on the part of his men and plant. Too often there is a loss of time and effort due to a failure to spend a day on planning the job. A few hours of proper planning may save many days of actual work.

A Military Engineer need not be a reckless hero but should display a moderate degree of COMPOSURE under enemy action. If he himself can not set such a standard, he can not expect his men to perform normally under enemy fire and bombing. In the final analysis, it should be relatively easier for an engineer to conduct himself normally under enemy fire. With an analytical mind and a knowledge of the theory of probability, he is in a better position to gauge the relatively slight chance he is taking and control himself accordingly. It is normal and human for individuals to fear enemy rifle and machine-gun fire and bombing activity. The engineer should appreciate, however, that it is most difficult* for a bomber moving several hundred miles per hour at great height to drop its bomb at the exact spot at which the pilot or bombardier is aiming. We should also be aware that a bomber is not going to waste an expensive and important bomb on a single *homo sapiens*, irrespective of the high value and importance which we as individuals attach to ourselves. We should appreciate first, therefore, that that particular bomb is not out to get us individually. It is only the one marked "To Whom It May Concern" that we need worry about. If we assume that we occupy a square yard of space, we should appreciate that there are 3,097,599 other similar areas in the square mile surrounding us. If we buy a ticket for a lottery in which that number of tickets is sold, we assume we have tossed that dollar away, as we know we are not going to win. We should similarly feel that the bomb which is dropped into that area is not pointed in our direction and has an insignificant chance of hitting us. This does not mean, of course, that it is recommended safe practice to place oneself in the middle of an airfield when they are bombing a drome; but we should feel that there is a reasonable degree of security in a fox hole or on the ground, even though in the general proximity of the target area, and by our own composure we should be capable of engendering that same feeling in our men.

We should also appreciate the difficulties the average soldier or new recruit has in putting all of his bullets into a fixed bull's-eye at any moderate range even under conditions when he knows the exact range, the windage, and he is in a secure firing position, is merely shooting holes in paper, and with no one disturbing him other than an over-anxious sergeant or lieutenant. We, as Engineers, should, therefore, be able to evaluate the reduced chances of being hit when we are a moving, indistinct target at an unknown range being fired at by a wheezy, little yellow slant-eyed (censorship prevents). We should also appreciate that only a small percentage of those engaged in any combat actually become casualties and that of that small percentage only a still smaller percentage die. In fact if you talk to yourself long enough on these lines, you can feel that war is a relatively safe proposition. But seriously, a full consideration of the probability phases of combat, insofar as fear of our permanent loss to the military establishment is concerned (wholly aside from the natural and selfish instinct for life, family, and the pursuit of happiness and other earthly comforts), can instill in the Military Engineer a degree of composure under fire which others may fail to understand. It will, in any case, be helpful toward adopting that attitude which the Military Engineer must have if his men are to carry on under him under all conditions that will have to be faced.

The Military Engineer must continuously exercise ACTIVE RECONNAISSANCE. He must reconnoiter the area in which he is engaged, evaluate the difficulties which may be encountered, and determine and know the engineering resources that are available in that operations area. He should know the condition of roads, bridges, and railroads and their potential sources of trouble. He should devise plans *beforehand* as to what he must, can, and will do to handle those problems. He should know where sources of timber, gravel, water, barbed wire fences, stocks of engineer tools, plant or supplies are available. Only by continuing reconnaissance will he remain a jump ahead of such problems and contingencies that will be continually arising.

The Military Engineer who is full of "book larnin" but who lacks the personality, vigor, forcefulness, leadership, and driving energy to put that knowledge across will fail.

There is a time and place for everything. In permanent peacetime engineering, the construction of a large bridge, a dam, a power plant, or similar permanent massive structures merits and requires detailed and thorough planning to ensure the most economical and efficient structure. In time of war the relative importance of the various factors entering military construction varies. The most important criterion is to get the job done on time to a degree adequate to meet the requirements of the situation, even though temporarily, irrespective of cost. This does not mean that the cost factor is completely disregarded, as cost is but another measure of materials, plant, and labor which should, of course, be conserved to the greatest degree possible in order to execute a greater extent of work. It is important, however, that the Military Engineer appreciate that high cost or utilization of valuable materials, if such are the only ones available, which must be thrown into a job in order to get it done as and when required, or destruction of valuable installations which might otherwise fall into enemy hands, should at no time bar or handicap his operations. A Military Engineer should be prepared to throw in all of his resources of whatever nature in order to get whatever job is assigned to him done on time. An airfield not available on schedule to meet tactical requirements, or roads, bridges, or trails not provided in time to sustain an attack represent failures of the engineer mission. They must be provided in the face of any obstacle.

The engineers are among the first ones in and the last ones out. The Military Engineer in time of war is rough, tough, and fast. His whole mental make-up and characteristics must be adjusted to that tempo if he is to accomplish his job.

He Must Have Professional and Technical Knowledge to Carry Out Large Construction Projects

Appendix I
Acronyms and Abbreviations

Acronyms and Abbreviations

A-DAY	Assault Day
AFPAC	Army Forces, Pacific
AFWESPAC	US Army Forces, Western Pacific
ALCAN	Alaska-Canada (Alaska Highway)
ASCOM	Army Service Command
ASME	American Society of Mechanical Engineers
CCC	Civilian Conservation Corps
DSC	Distinguished Service Cross
EAC	Engineer Amphibian Command
EBSR	Engineer Boat and Shore Regiment
ENCOM	Engineer Construction Command
ESB	Engineer Special Brigade
ETO	European Theater of Operation
ETOUSA	European Theater of Operation, US Army
FDR	Franklin Delano Roosevelt
FECOM	Far East Command
GENED	General Engineer District
GHQ	General Headquarters
KU	Kansas University
LAM	Landing Craft, Medium
LCVP	Landing Craft, Vehicle and Personnel
MAN	*Maschinenfabrik Augsburg-Nürnburg*
MERALCO	Manila Electric Company
MIT	Massachusetts Institute of Technology

OCE . . . . Office, Chief of Engineers
OPD . . . . Operations Division

PIANC . . . . Permanent International Association of Navigation Congresses
PMS and T . . . . Professor of Military Science and Tactics
PT . . . . Patrol torpedo
POL . . . . Petroleum-oil-lubricants
PSP . . . . Pierced steel plank

QM . . . . Quartermaster

RAAF . . . . Royal Australian Air Force
RAE . . . . Royal Australian Engineers
ROTC . . . . Reserve Officers Training Corps

SAME . . . . Society of American Military Engineers
SWPA . . . . Southwest Pacific Area

TVA . . . . Tennessee Valley Authority

USAFFE . . . . US Army Forces, Far East
USAFWESPAC .... US Army Forces, Western Pacific
USASOS . . . . US Army Services of Supply
USMA . . . . United States Military Academy
USO . . . . United Services Organization

VMI . . . . Virginia Military Institute
WES . . . . Waterways Experiment Station

Appendix J
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