

CONSTRUCTION DIVISION
OF THE ARMY



COMPLETION REPORT

CAMP KNOX

Kentucky

SEPTEMBER 1, 1919

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CONSTRUCTING QUARTERMASTER

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FOREWORD.

Because of the large scope of this project and the multiplicity of details, it is believed that this report should generally be confined to those elements which had a large bearing on the problems of construction at Camp Knox and eliminate as many details as possible on the theory that minute detail will interfere with the clear understanding of these problems. Some aspects of the work were not generally met with on other emergency construction and these are developed more in detail.

The uncompleted work on the Hospital, Liberty Theater, Civic Center, Refrigerating Plant, Incinerator, etc., which was stopped by Congressional action, as described on Page 5, is not segregated from the completed portions in the text. It is thought a complete description of the authorized camp is more concise and will be of more real value than an attempt to describe the completed portion now and follow with a supplementary report later, as it is altogether likely the relatively small amount of work required to complete will be released by the time this report is issued.

This report is a composite made up by the various heads of departments of the Constructing Quartermaster's organization and each man contributing wrote up the things which were directly connected with his duties. The whole was edited by J. X. Cohen, H. R. McIlvaine and the Constructing Quartermaster. Acknowledgement is made for copy and suggestions to Captains Robert Trimble, Jr., W. R. Renwick, Wirt Smith, E. A. Randall, Lieutenants Howland, S. R. Parke, Messrs. Thomas Fleming, Jr., J. P. McDonald, George Ehrenborg, L. A. Callahan, D. O. Clayton, O. L. Schlumpf, F. R. Willey, C. H. Loughridge, J. C. Lewis, D. T. Smith and W. C. Krause.

LOCATION.

Camp Knox is located thirty miles south of Louisville, Ky., on the high lands directly adjacent to the Ohio River bottoms. The Reservation covers parts of Hardin, Meade and Bullitt counties and is large enough to permit maneuvers and artillery firing on a large scale. Firing on a seven mile range may be had on a three mile front.

This location was chosen for several obvious reasons; viz.

1. It is near the center of population of the United States.
2. It is near enough a large city to share in the benefits of a city but far enough away to eliminate most of the disadvantages.
3. It is on high, well drained land and is a healthful site.
4. It is on a terrain which is broken and varied enough to make it ideal for artillery practice and the study of gases.
5. It is practically at the intersection of several national highways by means of which a rapid overland movement could be made to any part of the country.

Military Highways.

The following is a list of the larger highways which are either in process of building or are under improvement:

The Dixie Highway, (Mackinaw City, Mich., to Miami, Fla.) passes through the camp center in a north and south direction;

Fourteen miles south on the Dixie Highway, at Elizabethtown, the new Central Way, (Washington, D. C. to Texas) crosses east and west;

The new Jackson Highway (Chicago to New Orleans) passes fifteen miles east of Camp, with connections as follows:

1. At Louisville via Dixie Highway;
2. At Bardstown via Dixie Highway to Elizabethtown and Central Way to Bardstown.
3. At Nashville, via Dixie Highway.

The new River Road joins the Dixie at Tip Top on the Reservation and connects with Central Way at Owensboro. The River Road in general follows the Ohio and with the Central Way, Dixie Highway and connecting roads at Louisville will parallel the Ohio from Cincinnati to Paducah.

CONSTRUCTION HISTORY.

Construction Q. M. Arrived July 26.

On July 26, 1918, the Constructing Quartermaster, together with an assistant, arrived at Stithton, Ky., ready to organize for the construction of a six brigade artillery camp.

Arrangements were immediately made with the Constructing Quartermaster at Camp Taylor to take over the surveying party under his jurisdiction which had been doing some preliminary topographical work on the site.

Preliminary Surveys Rushed.

As practically nothing had been done towards the mapping of the proposed site, this was considered the most important work and was pushed as rapidly as possible, for on this survey depended the location and arrangement of the brigades and other units of the camp.

The Camp Planner arrived on July 27, and the final tentative locations of the brigades were made during the ensuing week.

The site of the camp finally chosen is known as "Site No. 2," in a report made by Capt. F. B. Smith to the Construction Division, attention Major Gibbs on May 25, 1918. This report, attached as "Exhibit A," was the result of an investigation of the country in the vicinity of West Point and Stithton, with a view of establishing a two brigade artillery camp requested by Brigadier General Jervey, Director of Operations.

Preliminary Activities.

On June 29, 1918, Capt. Smith again proceeded to the present location in order to secure data to be used in estimating the cost of a six brigade artillery camp, with an Officers' Training School for 10,000 men and auxiliary units necessary for such a camp. A report, copy attached marked "Exhibit B," of his findings was made to the Engineering Branch of the Construction Division, attention Major Gibbs, on July 8, 1918.

Prior to his arrival in Stithton the Constructing Quartermaster spent some time in Washington, D. C., getting together drawings, data and information about materials. Materials were ordered from the bulk schedule of a 45,000 man camp rather than to wait for an individual schedule of this particular camp.

Upon arrival at Stithton it was found that materials were ready to come in, and that approximately 500 cars were rolling. An organization was immediately thrown together and materials unloaded as rapidly as they could be handled. The siding at Stithton would not accommodate more than 11 cars at any one time and track material was

secured and temporary unloading tracks thrown in as rapidly as possible. A commissary was started, a preliminary lay-out made of one brigade and actual construction started on barracks buildings.

Contractor Arrives August 5th.

On August 5th, the general contractors arrived, but did not take over actual construction until about 10 days later, during which period he was shaping up an organization. The time-keeping and accounting was taken over on August 21, 1918, and the commissary on August 28, 1918.

There were no housing facilities for labor at Stithton worthy of the name and local barns and tobacco warehouses were commandeered and fitted up as bunk houses. Stithton is 30 miles from Louisville, on a single track line, and the railroad service was not suited for commuting although work trains were operated successfully after September 17, 1918.

The site of the cantonment is located on a divide between two water sheds, and the local supply of water very quickly proved inadequate. A temporary system was immediately designed, materials for same assembled and pipe laid. This work was pushed to completion as rapidly as possible, but it was not until the middle of September that the supply became available. In the meantime 15 tank cars were operated between Stithton and Cecilia to furnish the necessary water.

Period of Emergency Construction.

Work progressed in all branches utilizing ever available day light hour for seven days a week until the signing of the armistice. During this period there was a constant labor unrest and in spite of all efforts, it was physically impossible to recruit to anything like the number of men deemed necessary to put through the original program. There was a chronic shortage of common labor as compared with other trades, and the quality of all labor was very poor.

Immediately after the signing of the armistice, all over-time was eliminated, which resulted in the exodus of a large proportion of the labor, and conditions became so alarming that on December 21, 1918, all construction work was stopped and all contracts abrogated. This ended the first phase of the work and will be described hereafter as the period of "Emergency Construction".

Period of Purchase and Hire.

In order to complete a portion of the camp in all details it was determined to go ahead by direct

purchase and hire, and the Constructing Quartermaster organized a force for this purpose. Active construction on a large scale began about the first of February. (See Organization Chart Exhibit I.) Work was carried on by this organization until June 30th, at which time the organization was disintegrated due to the fact that all funds available were of the fiscal year 1919 and obligations could not be incurred subsequent to that date. This period will be described hereafter as the period of "Purchase and Hire."

Later Work.

The remaining work on the authorized program was let on lump sum contracts which contracts were executed prior to the 30th of June. On July 1st, work was started on all four of these contracts. On July 5th a preliminary order to stop all construction work was received which was confirmed on July 7th, and all work stopped immediately. Congressional action prohibited the continuance of construction work, payments of bills of labor of any nature whatever, and all acquisition and disbursements for real estate. The contractors disbanded their forces and the Constructing Quartermaster retained only such force as was necessary to put his accounts in shape. On August 18th notification was received that Congressional action had released the payment of obligations for labor and materials incurred prior to the 1st of July, excepting the completion of the camp by contract and the purchase of land.

Authorizations.

The original authorizations for the Camp were for the housing for approximately 60,000 men 27,000 animals. They consisted of six Brigades of Field Artillery (war strength), Division Headquarters, a Firing Center, two Labor Battalions, Veterinary Hospital, a Remount Depot, two Balloon Companies, Officer's Training School of 10,000 men, Aerial Squadron, Miniature Range, Artillery Park, Quartermaster's Depot, Ordnance Depot, Base Hospital of 2500 beds, and all the utilities, roads and civic buildings necessary for a Cantonment of this kind.

At the signing of the armistice the Camp was tentatively reduced to four Brigades, and such service buildings as it seemed expedient to finish. This program was again reduced on February 24 to three Brigades, reducing the capacity of the Camp to approximately 22,700 men.

The Officers' Training School, Remount Depot, one Balloon Company

and one Labor Battalion were eliminated. The Hospital was reduced to 725 beds and the various utilities and depots in proportion to the size of the camp insofar as construction would permit.

The roads, water, sewers, electric lights and other utilities were adapted to the new conditions as far as possible. Work had progressed so far however, that the skeleton of the larger camp still remains, with its utilities and is capable of expansion to the larger camp at a relatively small expense.

DESCRIPTION OF THE LAND.

When the Government occupied the land in and around Stithton the community was a farming community typical of north central Kentucky. The land is rather poor and broken, subject to a considerable scour and better adapted perhaps to grazing than to farming, although in some parts of the range fair crops of corn, oats, melons and tobacco are raised.

The roads were very poor. There were practically no rock roads except the old Dixie Highway which had been worn down to its telford base and was in bad condition. Most of the other roads were dirt and poorly designed. There was no swamp land but numerous ponds which were caused by sink holes described below. The draining of these ponds is a problem which must be met sooner or later in the immediate vicinity of the cantonment. At present they are oiled by the Sanitary Corps but it will require a large amount of work to effectually drain and fill them. There was very little clearing to be done as most of the trees were preserved, also shrubbery, as far as possible.

Topographic Features.

Camp Knox is located on a table land fronted on the north by the bottom lands of the Ohio River and draining to the east into Salt River and Mill Creek and to the west into Otter Creek. All of these streams are tributary to the Ohio River.

The land itself, in the cantonment area, is rolling and because of the numerous small draws is a difficult location for the construction of the camp. This particularly affects the roads, sewer and water. The land whereon the Spring sectors are located is fairly level but the remainder of the range is rugged. Perhaps thirty per cent of the area is in timber and the remainder farm land of low fertility with the exception of the portion of bottom lands near West Point on which the temporary camp was located. The elevation of the land varies from 430 feet above sea level at the old temporary camp to 690 feet at the present camp site.

The sub soil is red and yellow clay with a top soil two to six inches deep produced by decaying vegetation and seems to be deficient in humus, nitrogen and phosphorus, probably due to the fact that the land washes very easily. Sedimentary limestone underlays at a depth of from six to thirty feet and outcrops along the streams forming precipitous and rugged banks. This formation produces many springs and a water-bearing strata seems to extend under the entire area at a depth of from 80 to 120 feet. This strata is too thin to be of any practical value as a source of a large water supply but was satisfactory for individual wells.

Natural gas is present in the Ohio and Salt River valley at a depth of 250 to 300 feet and it is probably present on the Government reservation although this has not been definitely determined.

The Sink Holes.

The most striking topographical feature is the sink holes. These are produced by the scour of the underlying limestone which forms caverns, the roofs of which eventually collapse. The surface then settles down and in many cases there is an opening between the fault in the rock and the surface through which there is a constant scour of surface soil. In other cases the clay seems to form a puddle and stop the scour so that surface water accumulates in the sink holes, forming ponds. These ponds vary from a few feet in diameter to several hundred feet and vary in depth from a few inches to ten feet. The surface soil scours very readily and it is with great difficulty that drains of any kind are kept open.

ATTITUDE AND ACTIVITIES OF LOCAL PEOPLE.

When the actual inspection with a definite decision to locate was begun there was quite a good deal of uneasiness and speculation among the people as to the possible boundaries, manner in which the land would be acquired and the time necessary for the completion of the title reports so they could be paid, if taken in.

Information pertaining to such subjects was very carefully given and every effort made to explain fully the process under which the Land Office would work relative to acquiring property.

A thorough understanding of the status of the case was made possible by the close co-operation of the Title Companies, and each individual owner was given all the assistance available in order to expedite the settlement of his transaction.

The first tract of land occupied by the Government was acquired by

lease and contained approximately 10,000 acres near the town of West Point. The terms of the leases provided certain rentals to be paid by a disbursing officer on a monthly basis but due to the excessive work in Washington incident to the war, this was delayed and caused the community to question the good faith of the Government. Upon recommendation of the local office moneys were sent to pay past due rentals, which relieved the situation.

With the above exceptions the attitude of the owners was very favorable and if their property was required for military purposes they surrendered it good naturedly when called upon, leaving terms and price for further negotiations and offered no obstructions to the military program.

Appraisal Board Carefully Selected.

Greatest care was exercised in the selection of the appraisal board and as the result of careful investigation three men were appointed who were known throughout the entire territory as being men of the highest character and respected for their honor and high principles. These men were thoroughly familiar with all the property to be appraised and were capable of assessing a fair and just compensation for all lands approved for purchase.

This resulted in confidence in the appraisal board, as well as the representatives of the Land Office, and the greater portion of the property owners were favorably disposed toward the Government. There was some criticism from owners who held their property at exorbitant prices but these were in the minority.

ACQUISITION AND PURCHASE OF LAND.

Recommendation for the site was made by Col. A. McIntyre of the 326 Field Artillery and within a very short time after its acceptance organization plans were completed by the appointment of an office and field force.

Acquisition of land was begun under the direction and supervision of Lieut. C. F. Howland and Mr. J. R. G. Ivey of the Real Estate Section of the General Staff.

The task of getting options preliminary to the purchase of this range was found very difficult, due to the fact that the ownerships were unknown and could only be established by a thorough canvass of the territory involved and on account of the country being hilly and traversed by numerous meandering highways and streams making it almost impossible for anyone not familiar with the territory to find his way about.

Notwithstanding the difficulties encountered very satisfactory progress was made in obtaining necessary data.

Title Guaranty Policies.

After all necessary options, proposals and agreements had been received from the property owners the detailed information was submitted to the company conducting the investigation of titles and they in turn furnished to a representative of the Land Office at Camp Knox, a report showing condition of title, noting incumbrances if any and agreeing to issue to the United States of America a title guaranty policy thereon as soon as incumbrances were removed and the deed to the Government recorded.

Upon examination of the deed and finding it properly executed an officer of the Land Office prepared a voucher for the amount to be paid for the property and had the same signed by the grantor.

Procedure of Purchase.

Request was then made to the disbursing officer for check made payable to the grantor for amount stipulated in voucher, this check turned over to the company insuring the title with instructions to deliver it to the grantor as soon as all incumbrances against the property being purchased had been removed and a deed vesting title in the Government recorded with the proper County official.

In the event the grantor was not in position to pay the amount of incumbrances, if any, he was instructed to endorse check over to Title Company, authorizing them to deduct from the amount thereof a sum sufficient to pay all indebtedness against the property conveyed.

After making the necessary deductions, a statement of which was furnished each owner, the Title Company paid over to the grantor the remainder of the purchase price.

Procedure as outlined above has been invariably used where the land has been purchased. In some instances judicial procedure was necessary to vest possession and title, both because of defects in title which could not be straightened out and the refusal of property owners to accept the appraisal price for land.

Boundaries of Camp Knox.

A general description of the boundary of Camp Knox is as follows: Running east from the junction of the L. H. & St. L. and I. C. R. R. along the I. C. R. R. to Salt River R. R. Bridge; thence in a northeasterly direction for a mile and a half along the ridge of the high land; thence in a general southerly direction east and north of Salt

River along the ridge of the high rough country keeping about two miles from Salt River. (This tract east of Salt River is rugged, rough and heavily timbered, and is very cheap but is essential as a back stop for all artillery firing conducted in an easterly direction, which is the general direction of fire). Continuing from the crossing of Salt River in a general southwesterly direction, the boundary is so laid out as to include Mill Creek which has been adopted as the outlet for the cantonment sewerage system. The boundary has been extended south of Stithton to include the junction of the old and new Dixie Highways, thus allowing ground for the placing of a remount depot and camp utilities which may be adopted at a later date and to avoid the paying of damages for construction work on the new Dixie Highway and grading and switches on the I. C. R. R. Extending from Stithton in a westerly direction, the boundary is run to include the reservoir and the source of the water supply which lies just west of Otter Creek and south of Grahampton. Extending from the Tip Top-Grahampton road the boundary is laid in a general northerly direction so as to exclude the more expensive low ground bordering on Otter Creek.

Farm Boundaries Followed.

It has been found necessary to follow farm boundaries rather than previously determined straight lines. It is quite obvious that if straight line boundaries were followed there would be instances in which farm houses would be isolated from the farm property, thus doing the owners a grave injustice.

The entire tract is a rough, rolling piece of country and in all instances where practicable valuable low land has been excluded from purchase.

Acreage.

The acreage of Camp Knox is as follows:

Hardin County	22.662
Bullitt County	5.840
Meade County	7.828
Total acreage	36.330

CONTRACTOR'S ORGANIZATION.

During the period of Emergency Construction the backbone of the organization of the General Contractor for the cantonment were either men from his own commercial

organization or from other Chicago contractors. The remainder were recruited locally. (See Exhibit H for Organization Chart.) The following were the contractors and sub-contractors operating during this period; viz,

General Contractor for Cantonment.

John Griffiths & Son. Co., Chicago.

Sub-Contractors for Cantonment.

M. J. Carboy Co., Chicago (Water and Sewer).

White City Electric Co., Chicago (Electric Wiring).

Hanley & Co., Chicago (Heating and Plumbing).

Knisely Bros., Chicago (Sheet Metal).

Zander-Reum Co., Chicago (Plastering).

J. B. Noelle Co., Chicago (Painting).

Chas. Weghman Co., Chicago (Commissary).

Louisville Rendering Co., Louisville (Sanitation).

Anderson & Schardein, Louisville (Temporary Water Supply).

F. G. Breslin, Louisville (Roads).

Warren Bros. Co., Boston (Roads).

Andrews Burns Co., Columbus, O. (Roads).

Louis Rich Con. Co., East St. Louis, Ill. (Roads).

Kreis & Wardrep, Knoxville, Tenn. (Roads).

L. W. Hancock, Louisville (Railroads).

Nugent & Hoke, Louisville (Railroads).

General Contractor for Power Transmission Line.

Louisville Gas & Electric Co., Louisville.

The only contractor operating during the period of Purchase and Hire was the Louisville Gas & Electric Co. on the Transmission Line.

The contractors who started work on a lump sum basis subsequent to July 1, 1919, were

General Contractor

The Weller Const. Co., Washington, D. C.

Completion Dixie Highway

F. G. Breslin, Louisville.

Completion Heating and Plumbing

Ives, Hanion & Lewis, Louisville.

Completion Incinerator

Ansonia Contracting Co., New York City.

RECEIPT OF MATERIALS.

MATERIAL	QUANTITY	Ordered	First Shipment Received
Brick	1,500,000	7-25-18	8-3-18
Cement	75,000 Barrels	7-25-18	8-5-18
Electrical—Inside Wiring	Preliminary Schedule	7-25-18	8-15-18
	Bulk Schedule	9-15-18	10-15-18
	Hospital	10-14-18	11-5-18
	Aero Squadron	10-24-18	11-2-18
	Stables	11-8-18	12-5-18
Electrical—Outside Wiring.....	Preliminary Schedule	9-18-18	10-18-18
	Bulk Schedule	9-23-18	11-20-19
	Transformer Schedule	10-18-18	11-20-18
	Copper Schedule	3-20-19	5-10-19
Electrical—Transmission Line	Preliminary Schedule	9-13-18	9-28-18
	Bulk Schedule	8-26-18	10-25-18
Fire Apparatus	Preliminary Schedule	8-17-18	8-20-18
	Bulk Schedule	9-9-18	10-20-18
	Hospital Schedule	10-11-18	1-10-19
	Aero Squadron	10-26-18	1-10-19
	Warehouse Alarm	2-6-19	3-1-19
Hangars	Four		11-30-18
Hardware	Bulk Schedule	7-27-18	8-6-18
Lumber 1st Order.....	44,873.131 ft. B. M.	7-26-18	8-6-18
2nd "	15,815.257 ft. B. M.	8-27-18	9-10-18
3rd "	456,825 ft. B. M.	9-16-18	10-1-18
4th "	7,420.793 ft. B. M.	9-23-18	10-15-18
Total Ordered	68,571,056 ft. B. M.		
Total Received	54,067,528 ft. B. M.		
Balance Cancelled or Diverted	14,503,528 ft. B. M.		
Millwork	Add. Schedule	8-26-18	9-7-18
	Bulk Schedule	7-23-18	8-6-18
	Refrigerator Plant Schedule	9-13-18	10-1-18
Nails	Hospital Schedule	9-27-18	10-10-18
	25,000 Kegs	7-27-18	3-7-18
Paint (For Hospital Only)	2,000 Gallons	3-24-19	4-15-19
Plumbing	Bulk Schedule	7-29-18	8-30-18
	Hospital Schedule	9-25-18	10-15-18
	Add. Schedule	10-7-18	12-5-18
Railroad Material	Bulk Schedule	7-27-18	8-30-18
Refrigerating Plant	1— 73 Ton	9-9-18	Cancelled
	1— 100 Ton notbuilt	11-11-18	12-1-18
	1— 35 Ton	5- ?-19	6-5-19
Roofing (2-Ply)	94,802 Rolls	7-20-18	8-30-18
	(1-Ply)	16,350 Rolls	7-20-18
Screening and Expanded Metal	Bulk Schedule	7-27-18	8-10-18
Sewer Pipe and Materials	Preliminary Schedule	8-20-18	9-16-18
	Bulk Schedule	9-12-18	10-5-18
	Pumping Engine etc.	3-1-19	4-15-19
Sheet Metal	Bulk Schedule	7-20-18	8-10-18
Steam Heating Boilers	20— 150 H. P.	7-20-18	Cancelled
	4— 500 H. P. notused	9-5-18	11-1-18
	6— 150 H. P.	2-1-19	3-15-19
Miscellaneous Material	Bulk Schedule	9-9-18	10-20-18
Stoves, Heaters, Ranges	Preliminary Schedule	7-27-18	8-15-18
	Bulk Schedule	9-11-18	10-5-18
Wall Board	3,559.346 sq. ft.	7-20-18	8-30-18
Watering Troughs	326	7-20-18	9-10-18
Water Pipe and Materials	Bulk Schedule	7-20-18	8-8-18
	Chlorinators	8-10-18	8-18-18
	Pumps	8-15-18	5-1-19
	Wood Tanks	9-16-18	11-5-18
	Eight		

Delay in Receipt of Material.

As a rule the ordinary building materials and equipment were delivered without undue delay. The greatest delays were in the delivery of special materials and equipment, notably electrical material and pumps. The most serious delay was in sheet metal. While the initial deliveries were made promptly the materials required to assemble complete ventilators were not delivered for sixty days and smoke jacks for ninety days. The last named caused a serious condition inasmuch as it was necessary to install heaters in barracks and mess-halls before the weather became too cold to make them habitable. It was impossible to manufacture enough smoke jacks locally to meet the demand and it is certain that this feature caused an appreciable part of the labor turnover.

It will be noted the statistical information tabulated above gives no hint of the serious delay in the receipt of sheet metal and to that extent is misleading. However the date of receipt of first shipments of the various classes of material is a pretty fair index of the service rendered by the various manufacturers and the sheet metal instance is the most notable exception.

LABOR.

Unskilled Labor Difficult to Obtain.

The labor situation during the construction of Camp Knox presented two distinct phases:

First, conditions under the general contractor, with the co-operation of the U. S. Employment Service of the Department of Labor in securing employes, and,

Second, conditions under the Constructing Quartermaster, after taking over the general contractor's functions, with the co-operation of the Civil Service Commission in securing employes.

The greatest employment difficulty of the camp has always been that of securing a sufficient number of unskilled laborers. From August 12, 1918, the date of the organizing of the contractor's employment office, to January, 1919, a total of 39,111 men were employed, of whom 11,912 were common laborers. The largest number of any class was carpenters—12,188—and the next largest division after laborers was commissary employes—3,032.

In August, 1918, an executive order prohibited the recruiting of labor by any agency other than the U. S. Employment Service, and the majority of the laborers mentioned above, with the exception of those who applied in person at the camp, were recruited through that Service. United States Employment Service Co-operates.

Transportation was advanced on

Government transportation requests only to unskilled laborers, and while the Employment Service made an especially active campaign in Kentucky, probably the greater number of men were shipped from Missouri and Oklahoma, the individual fare in some cases being as much as \$37. All shipments were accompanied by recruiters or guards, and the class of labor then available made it necessary in many cases to ship men in locked coaches to prevent their wandering away en route.

No figures are available to show the turnover for this period, but it was extremely high, due primarily to the universal scarcity of labor of all kinds, and in the case of unskilled labor to the fact that the original rate here was only thirty cents per hour, having been fixed by the War Labor Policies Board. This rate was effective until September 18, 1918, at which time it was increased to thirty-five cents. In February, 1919, another advance of five cents was made, making the final rate forty cents per hour. Up to November, 1918, however, the men were able to earn over-time and to work Saturday afternoons and Sundays, for which they were allowed double time, so that their aggregate earnings were considerably more than the rate would indicate.

The number of persons employed as unskilled laborers does not represent the total number of men so engaged, inasmuch as under emergency construction the shortage of common labor forced the use of skilled labor in places where unskilled labor would be used under ordinary conditions.

Acknowledgement is made here of the most excellent service rendered the project by the district office of the U. S. Employment Service under Messrs. W. Pratt Dale and O. L. Taylor, and the various chapters of the Kentucky Council of Defense. It was through their extraordinary efforts and earnest co-operation in territory which had already been combated for labor that made recruiting for Camp Knox at all possible.

Effect of Armistice.

With the signing of the armistice the hours of labor here were reduced to eight hours per day without Saturday afternoon and Sunday work, making a forty-four hour week, as contrasted with the seventy-five to ninety hour week, which previously obtained. As a result of what amounted to practically 50 per cent. wage reduction the men left camp in large numbers, and the maximum force of 14,000 rapidly dwindled, and when the work was temporarily shut down on December 21 the force had been reduced to between 1,500 and 2,000.

From August to January condi-

tions were such that the contractor was practically compelled to take men of any type for unskilled laborers, and there was no physical examination of any kind, nor was there an inquiry into the man's past record.

Labor Unrest.

During the period of emergency construction there was a constant undercurrent of labor unrest. Scarcely a day passed without a grievance, demand, strike or walkout. In spite of the constant menace there were few strikes and walkouts prior to the signing of the armistice. Subsequent to that date the following strikes and walkouts had a large bearing in the progress of construction:

Trench machine operators, November 14, 1918; not settled.

Plumbers and steam fitters, Nov. 26; returned December 16.

Electricians, sheet metal workers and painters, December 4; not settled.

Labor leaders claimed these were unauthorized walkouts but the stage was all set for a big general strike about the middle of December which was stopped by the announcement that the work would close down on December 21.

Period of Purchase and Hire.

When the project was taken over by the Constructing Quartermaster from the contractor the personnel automatically became civil employes of the United States, subject to the rules and regulations of the United States Civil Service Commission, and the Civil Service Commission was designated as recruiting agent, a Board of Civil Service Examiners being established at the camp, with an employee of the Construction Division designated as Local Secretary. The Civil Service Commission, through its representatives in various cities and at the camp has recruited all labor for the camp since January 16 with satisfactory results. A total of 16,216 men have been employed between January 16, 1919, and May 16, 1919, of whom 10,954 have been laborers.

Laborers Examined Before Shipment.

Laborers have had their transportation paid on Government transportation requests through the Civil Service Commission, but before any man was shipped, he was required to undergo a rigid physical examination, to furnish a satisfactory letter of recommendation, and to give a brief outline of his previous experience. In consideration of transportation being advanced the employes sign an agreement to work for such period of three months as they may be needed. In most cases shipments of such men were not accompanied by a recruiter or guard, but the loss

in transit was very small, never exceeding 10 per cent. in shipments of 100 or more, and in most cases being considerably less. In some shipments of 100 or less there was absolutely no loss. This is contrasted with a minimum loss of 25 per cent. under war conditions, even when the men were shipped in locked coaches and accompanied by one or more recruiters. Transportation has been furnished only to unskilled laborers, and where skilled tradesmen shipped in as laborers and were employed in their trades, a check has been kept and transportation has been deducted. When men who have been shipped fail to report here an endeavor is made to secure a refund of transportation. Such endeavors have met with fair success.

The Value of Civil Service.

Men who apply at camp of their own accord are required to undergo a physical examination and execute a Civil Service application. Men applying for skilled trades are required to make sworn statements as to their past experience, four years at least being required for each trade, and their statements are verified by the inquiries sent out by the Board of Examiners. There have been probably 200 rejections on account of communicable diseases since the medical examination was started, and there have been a considerable number of rejections for heart disease and other non-communicable diseases. There is no record of the number of men rejected on account of experience, inasmuch as many men would leave or sign up as laborers when they understood the conditions of skilled employment. The number has been sufficient, however, to more than justify the system. The service has not suffered, either, as there has never been any difficulty in securing a sufficient number of skilled tradesmen, with the exception of outside linemen and plasterers. The difficulties in the case of linemen were probably occasioned by the fact that Local Utilities Companies were able to have their pick of men arriving in Louisville before such men reached camp.

A Complaint Bureau has been operated in connection with the Employment Office since early November. The function of this office has been to pass on all discharges and to remedy sources of complaint, so far as possible. In handling discharges that office has been of considerable value in collecting transportation from men shipped in who have not lived up to the three months' agreement. An extremely large number of discharges have been granted on account of sickness in the families of the men, the family in most cases residing at points outside of Louisville, the nearest

large center. While there is no question that in a number of cases the men have had their families write that there was illness when there was none, in most cases the claim has probably been true and the discharge had to be granted.

Some Causes of Turnover.

It is impossible for any number of men to have their families at the camp, and the prevalence of sickness and the natural desire of the men to see their families occasionally have been responsible for a large part of the turnover. These cases would not develop to so large an extent if the camp were close to a large center from which it could draw its labor. As the pay system is such that the week closes on Monday and pay-day is the following Saturday, to a man urgently in need of money a discharge is an attractive means of securing it, if he has earned any time, and, while strenuous efforts have been made to abolish the practice, it has been impossible to eradicate it entirely. The figure of 10,954 laborers hired in four months to establish and maintain a maximum force of 3,500 laborers seems high, but it should be understood that there are a number of duplications in this figure, due to men returning after having once left, and it is believed that the labor turnover was not excessive until the period of bad weather, which set in in May, when the men left in considerable numbers on account of weather conditions not permitting them to earn enough money.

In conclusion, it should be mentioned that, while industrial conditions were in a bad state throughout the country during the last six months of work on the Camp, there were no strikes here whatsoever, nor is there any known instance in which a number of men endeavored to embarrass progress by quitting in a group. Without question the fact that the men were working for the Government and were temporarily Civil Service employes had a stabilizing effect on them.

MORALE OF CONSTRUCTION FORCES.

During its construction Camp Knox was so situated as to be practically without means of recreation and amusement. It was quickly realized that the morale of the camp must be kept up to keep the labor turnover down and increase efficiency. A few private concessions were tried and proved failures. The next step was to try the organizations who were serving the army.

One of the first agencies called in was the Army Y. M. C. A. which conducted a group of huts distributed throughout the Camp at strategic locations and which rendered a highly effective service. To satis-

factorily control the situation arising out of the employment of a great many women in the clerical departments the War Camp Community Service was encouraged to extend its work to within Camp limits. The assistance rendered by this organization was of much moment. Paralleling the work of the Y. M. C. A. the Knights of Columbus were also requested to enter Camp and minister the civilian needs. The co-operation of the K. of C. has been extremely valuable and its efforts have been of service to the forces of the Constructing Quartermaster.

In addition the American Red Cross established a Home Service department which was capably managed and proved of great service to the men and women engaged on the construction of the Camp.

The American Library Association also established a branch from which they served the civilian population in a most satisfactory manner.

Late in October 1918 a weekly newspaper was founded to be published for the forces of the Constructing Quartermaster. The interest aroused among the workers soon reached the point where it became necessary to print rather than mimeograph it and the circulation grew to such an extent that practically every literate person in Camp was a reader.

Through this medium the Constructing Quartermaster was able to reach the entire personnel with orders and messages of general interest which served to allay baseless rumors of the sort that are continually being heard in a construction camp and the circulation of which are in general inimical to the welfare of the men and the interest of the Government.

The CAMP KNOX NEWS served as a means of cementing the various departments together and acted as the very best type of co-ordinator available. Upon the success of this paper can be based the positive recommendation that the construction camp organization should include as one of its elements a publicity organization. At Camp Knox this organization was recruited from the working force, practically all of whom contributed to the paper during leisure moments.

Through the agency of the NEWS a number of civilian activities were promulgated—a base ball league of eight clubs built on the twilight baseball schedule and worked up great interest. The NEWS also financed the issue of Service Buttons, a reproduction of which appears on the title page of this report. These Service Buttons together with service certificates (Exhibit J) were issued to civilian employees who had been satisfactory, and who had served at least thirty days. They

excited great interest and were greatly sought after. The surplus money derived from the various activities of the NEWS, together with the surplus of the Con Quar Club, a civilian organization, has been devoted to beautifying the small park opposite the Post Office and library, known as Con Quar Park, and to the building of an ornamental Drinking Fountain.

The fountain was designed by Mark Whitmeyer, of the Camp Planners forces, and executed by H. O. Wimsett, a member of the Constructing Quartermaster's forces, and the landscaping by W. L. Phillips.

RENTED EQUIPMENT.

Establishing correct valuations and rentals on contractors equipment required considerable study in order that the best interests of the Government be served and that the rights of the owners of the equipment be safeguarded.

As soon as practicable after the arrival of any piece of equipment, it was given a serial number painted on it in some conspicuous place. The machinery was then entered on a card index under this serial number, along with the shop number, maker's name, owner's name, contractor operating same, owner's valuation, Government valuation, condition of repair on arrival and daily rental.

All equipment was divided gen-

erally into two classes, viz:

Class I—Equipment owned by parties who had signed the Emergency form of contract or subcontract.

Class II—Equipment owned by individuals, but rented to parties who had signed the Emergency form of contract or subcontract.

Any equipment classified in Class I could therefore be taken over by the Government when the accrued rental equaled the value of the article, but, since the owners of Class II equipment were not legally bound by the contract, a special form of agreement had to be made with these parties provided they were willing to give title on their equipment to the Government when the accrued rental equaled the appraised valuation.

Daily rentals on equipment were based on the appraised value of the machinery, thus in case of the equipment belonging in Class I and that in Class II on which the Government had the right to acquire, an approximate daily rate was adopted equal to one-half of one per cent. of the appraised valuation of the piece of equipment.

The rate on all other equipment was based on a daily rate of one-quarter of one per cent. of the appraised valuation of the article or at the most advantageous rate to the Government that the owner would accept.

SCHEDULE OF EQUIPMENT USED							
No.	Article	Value	Rental Paid	No. Purchased	No. Rented	Returned No. to owner	
6	Adding Machines	\$ 1,188.00	\$ 506.16			6 2.23.19	
13	Automobiles	7,326.35	7,326.35	13 2.28.19			
17	Boilers	14,200.00	8,868.00	7 2.17.19	2 12.22.18	9 12.21.18	
2	Buckets (Clam Shell)	9,000.00	2,575.00			2 12.21.18	
3	Bins (Rock)	1,300.00	110.00	1 1.30.19		3 12.21.18	
7	Crushers (Rock)	21,300.00	15,379.00	4 1.31.19		1 12.21.18	
1	Compressor	1,000.00	193.00			4 12.21.18	
73	Carts Dump	4,668.00	3,517.00	31 2.18.19		3 3.25.19	
7	Cars Rock	320.00	513.29	2 1.30.19		7 12.21.18	
3	Comptometers	750.00	561.25			1 12.21.18	
34	Drills	8,404.00	5,782.84	16 2.21.19	11 12.22.18	1 12.21.18	
1	Derrick (Stiff Leg)	500.00	227.50			10 12.21.18	
29	Engines	27,320.00	18,567.95	14 3.1.19	5 12.22.18	1 12.21.18	
5	Fillers Back	10,100.00	5,372.50		4 1.10.19	18 12.21.18	
23	Graders Road	11,120.00	5,112.85	1 12.22.18	4 12.22.18	4 12.21.18	
5	Hoist Steam	14,000.00	5,952.50	1 1.30.19		12 12.21.18	
12	Lights Asstd.	62.00	274.78			33 12.21.18	
41	Mixers Concrete	76,857.50	35,256.94	5 2.1.19	2 12.22.18	53 12.21.18	
74	Plows	2,950.50	2,102.50	21 3.3.19		4 12.21.18	
11	Pumps	2,320.00	1,596.76	4 2.9.19	3 12.22.18	1 2.23.19	
1	Photostat Mch.	350.00	865.00			26 12.21.18	
21	Rollers Road	71,500.00	26,635.00	2 3.1.19	3 2.1.19	293 12.21.18	
566	Scrapers	27,550.50	18,509.20	253 2.28.19	20 12.22.18	3 12.21.18	
14	Shovels Steam	72,000.00	36,537.50	4 1.31.19		1 12.21.18	
1	Street Sweeper	400.00	12.00			13 12.21.18	
32	Saw R's	12,668.00	11,722.22	19 2.5.19		3 12.21.18	
3	Scarifiers	120.00	381.00			7 12.21.18	
7	Typewriters	700.00	154.50			6 12.21.18	
13	Trenching Mchs.	109,000.00	40,700.55		7 1.10.19	1 12.21.18	
1	Truck Road Oil	8,000.00	4,210.00			17 12.21.18	
17	Transformers	1,742.15	373.42			4 12.21.18	
5	Unloaders	7,100.00	4,928.00	1 1.31.19		5 12.21.18	
7	Well Drilling Outfits	7,000.00	2,717.50	2 2.12.19		48 12.22.18	
240	Wagons Dump	62,450.80	22,513.00	34 2.21.19	48 12.22.18	258 12.21.18	
41	Wagons Water	11,450.00	5,173.33			4 12.22.18	
53	Wagons Mixed	3,250.00	1,058.00			37 12.21.18	
1499		\$617,611.30	\$298,128.14	437	142	920	

FIRE PREVENTION.

Fire Protection During the Construction Period.

At the beginning of construction the town of Stithton was absolutely without fire protection equipment or a fire fighting organization. No enlisted personnel having been assigned, it was necessary to employ and organize a civilian fire squad. This was done and such equipment as was required was purchased or rented.

In addition Mr. C. H. Parker, of Louisville, a Fire Prevention Engineer, offered expert advice without charge and made several complete inspections of the camp. The suggestions he made were valuable and advantageous.

Enlisted Men Form Fire Company.

Early in September, 1918, a small company of enlisted men was organized at Camp Zachary Taylor (near Louisville,) and transferred to Camp Knox. This company was in direct charge of Sergeant Huard, a fireman of long experience. Upon request to the Construction Division, two small Ford fire trucks were sent here pending the arrival of the permanent fire engines.

Fire instructions set forth in the Instructions to Constructing Quartermasters were carried out as far as possible. Hand apparatus was distributed to various points in all Brigades. Fire barrels with buckets comprised the main fire-fighting apparatus in a large share of the camp. Fire extinguishers were placed in all buildings.

Few Fires.

During the entire period of construction only three fires of a damaging nature occurred. One of these fires did not result in a loss to the Government as the warehouse destroyed had not as yet been taken over by the Government. The interior of a standard sixty-six men barracks was partially gutted in another instance, the total loss amounting to \$500. The last fire totally destroyed a partially completed stable; the loss ensuing amounted to approximately \$3,000.

The Camp Utilities Officer under the direction of the Maintenance and Repair Division, arrived March 26, 1919, and shortly after took over the fire department and operated it during the balance of the construction period.

Station Equipment.

The Headquarters Building of the Fire Department, Station No. 1, located in Camp center, is, at the time of writing of this report, equipped with one Ahrens & Fox engine, mod-

el. 1K-4759 and two Howe-Ford engines, 250 gallon capacity.

Station No. 2, located in Motor Transport Corps area, is equipped with a South Bend double duty engine No. 194, Type BCH-80, 500 gallon capacity.

Station No. 3, located at the Base Hospital, is equipped similar to Station No. 2.

The Aviation Section is equipped with hand apparatus and guarded by their personnel.

CONSTRUCTION CAMP SANITATION.

Temporary Latrines Used.

Owing to the fact that the top soil at the site of the camp consists of a thick layer of highly impervious clay, it was considered advisable, in order to prevent ground pollution and to maintain proper sanitary conditions, to use temporary latrines of the can type rather than pitted latrines which would rapidly fill up and require repitting, thus entailing a large expenditure for ditching with unsatisfactory results. Latrines were built in sizes varying from three to sixteen holes depending on location relative to tributary population. By experience it was found that a seating capacity equal to five per cent. of the population was generally adequate.

*A door at the rear of each latrine gave access to the cans, which were removed, emptied and cleaned daily, or more often where necessary, clean cans being substituted. Where feasible, urine was removed by steel tank wagons provided with hand pumps and suction hose lines. In order to prevent the entrance of flies, seat covers were made self-closing by means of a plant placed above the seats. The can compartments were periodically sprayed with a mixture of one pound of bone black and three gallons of crude oil and screen tops were provided on urinal cans.

Throughout the portion of the camp center which formerly was the village of Stithton, surface privies had been universally in use and insanitary conditions were general. A careful cleanup of this district was made and can type latrines were substituted for the surface privies. In order to economize on the construction of temporary latrines, those out of service were moved on sleds drawn by tractors to locations where needed. After the completion of sewers and permanent lavatories in each district, the temporary latrines were closed, but a sufficient number were left in place for emergency use in case any interruption of the temporary water supply should occur.

Disposal of Sewage, Garbage and Other Wastes.

For a few weeks during the early part of the construction work, sewage and garbage hauled from the camp were buried in a field near the Sixth Brigade area. Owing to the expense thus entailed, steps were taken to provide some other means of disposal and a large ravine located to the east of the old Dixie Highway and about a mile southeast of the camp was secured for use as an incinerating dump for the disposal of garbage, rubbish and other wastes. As this ravine drains into a tributary of Mill Creek, the stream into which the outfall sewer will discharge, it was decided also to make use of this site for the disposal of excreta hauled from the temporary latrines. Consequently an improvised septic tank was formed by placing a timber dam across a small vine adjacent to the dump and a timber trough was constructed extending from this basin to a hopper in the unloading platform at the top of the ravine. Latrine cans were hauled by trucks and wagons to the unloading platform and were washed and steamed after being emptied.

Pending the installation of sewers, it was also necessary to haul the waste liquids from mess kitchens to this site for disposal. At the large mess halls dumps were excavated to receive the liquid kitchen wastes, which were then pumped into tank wagons by means of gasoline engine driven pumps. At the smaller mess kitchens the waste liquids were stored in large cans until collected. This method of disposing of dishwater and excreta was used until March, 1919, when a temporary outlet was secured for the outfall sewer discharging into a cave on the water shed of Mill Creek. Thereafter the excreta from the unsewered districts were discharged into a manhole on the outfall sewer adjacent to the old Dixie Highway in the Sixth Brigade area, an unloading platform and hopper being erected provided with water connection for flushing. The liquid kitchen wastes from unsewered districts were hauled to a grease trap discharging into a sewer manhole.

At the mess halls, garbage suitable for swine feed was separated from other solid wastes and farmers in the adjacent country were encouraged to haul the former away without charge, as it was found more economical to do this than to collect and sell this class of garbage from a transfer station. Grease and bones, however, were sold, the rate obtained being 34¢ a pound for the former and \$15.00 a ton for the latter. This method was pursued until March, 1919, when the Salvage Division took over the collection and sale of this class of wastes. Pending the construction of the camp incinerator all garbage unsuitable for

feeding to swine, rubbish, etc., were hauled to the camp dump and burned. Cans for trash, waste paper, etc., were provided outside the various barracks and office buildings and at several points throughout the camp center, collections being made daily.

Sterilizing Plant.

All garbage and latrine cans are steamed daily after being emptied. Steam was furnished by a 15 H. P. vertical boiler and piped along two platforms, each having six rising pipes, over which the cans were placed, the steam being liberated through whistle valves. The platforms were covered with sheet metal, drained to a central trough and were cleaned frequently with the aid of a steam hose. Cans soiled on the outside were immersed in a metal tank of lye-water heated by a steam jet and cleaned with wire brushes.

Disposal of Manure and Dead Animals.

During the early part of the work manure collected daily from the camp stables was disposed of by burning. Later when the demand for manure for fertilizing use was offered an outlet it was sold and shipped out by rail, \$7.50 per car being obtained. Since March, 1919, manure has been sold by the Salvage Division. In January, 1919, it became necessary to cover many temporary water lines with manure to prevent freezing. As soon as feasible, this manure was removed and sold. Dead horses and mules on the reservation were promptly taken to the camp dump, where the hides were removed and the carcasses were burned or buried. The hides were sold at rates varying from \$3.00 to \$5.00 each.

Sanitary Supervision of Mess Halls and Restaurants.

With the start of the construction work numerous tent restaurants and soft-drink booths were opened in the village of Stithton. As repeated efforts to have these vendors conform to proper sanitary regulations met with slight success, the operation of booths and tent restaurants was prohibited. Frequent inspections were made of the remaining restaurants and lunch rooms and also the mess halls of the Constructing Quartermaster and the following regulations were enforced:

- a. All restaurants and stores must be completely screened with satisfactory wire screening and provided with self-closing screen doors. All food-stuffs shall be kept in closed or screened containers.
- b. All garbage and rubbish must be promptly placed in sanitary metal containers, provided with covers.
- c. All dishes, cups, knives, forks, spoons and other utensils must be

promptly washed with clean hot water and scalded.

d. The use of common drinking cups or glasses is prohibited. Individual paper cups should be provided. However, straws may be furnished with bottled soft drinks in place of paper cups.

e. All tables, counters and other equipment must be maintained in a sanitary condition. Floors must be kept clean at all times and mopped daily.

e. Cats, dogs, chickens or other animals will not be permitted within places where drinks, food-stuffs, confections or tobacco products are sold.

f. Fly traps, fly swatters and fly paper must be used to minimize the fly nuisance.

g. Personal cleanliness of all persons engaged in handling foodstuffs, soft drinks, confections, tobacco products, etc., must be maintained at all times. Immediately after using toilet the hands must be carefully washed with soap and water.

h. Food-stuffs, confections or tobacco products must not be handled by customers before purchasing.

In April, 1919, specimens of excreta were obtained from all employes handling food in mess halls and kitchens of the Constructing Quartermaster and analyses indicated all specimens free from hookworm and the organisms causing typhoid fever or paratyphoid fever. This work was handled by the Camp Surgeon's Office and analyses were made at the laboratory of the Base Hospital, Camp Taylor.

Elimination of Polluted Water Supplies.

Throughout the village of Stithton numerous wells were in use as sources of water supply. Periodic analyses were made at the Base Hospital laboratory, Camp Taylor, of water samples collected from these supplies and whenever the results of analyses indicated sewage pollution the use of the well in question was stopped by removing the pump and the supply was placarded as dangerous.

Sanitary Supervision of Barracks.

Special precautions were taken to maintain the barracks occupied by the civilian forces of the Constructing Quartermaster in the best possible sanitary condition. Guards were on duty in each barracks from 6 a. m. to 10 p. m. daily and their duties included the making of beds, sweeping and mopping of floors, ventilating barracks, airing bedding, etc. In cases where vermin were discovered, bedding and clothes were sprayed with an insecticide and during the latter part of the work a steam sterilizer was also used for this purpose. Bath-houses were maintained for use of employes.

Mosquito and Fly Control.

During the summer and fall of 1918 the stagnant pools of water in camp, fire barrels, etc., were periodically oiled to prevent the breeding of mosquitoes. During 1919 this work was done by the Sanitary Detachment of the Camp Surgeon's Office. Special precautions were taken to minimize the fly nuisance by the prompt removal and disposal of manure, garbage, and other organic wastes and by the use of screens, fly traps, fly poisons, etc.

General Health Conditions.

During the entire period of construction work, the health of the employes in camp was excellent. During the influenza epidemic, which started here in the latter part of September, 1918, and lasted into January, 1919, the percentage of serious cases among the civilian employes was remarkably low. During this period there were only 733 cases of the disease and five deaths therefrom reported among the civilian population, which averaged 7,000 and ran as high as 12,000 people. Since the construction work started, no case of typhoid fever has been reported.

Cost of Sanitary Work.

The cost of the sanitary work conducted by the Constructing Quartermaster has averaged slightly more than \$3.00 per month per person employed on the construction work.

ROADS.

The "Dixie Highway" is the main thoroughfare traversing the Reservation. It was built with slave labor before the Civil War and was a fine example of old Telford road construction. Being too near the areas intended for artillery ranges, it was necessary to relocate a section 9.5 miles long farther west, and to pass it through the villages of Muldraugh and Stithton.

This section called "The New Dixie" constituted the main problem of road building with the Reservation. In March, 1919, a decision was made to improve the old road from the end of the new section near Tioga to the southern edge of the town of West Point.

Lately the Louisville Chamber of Commerce and Town Board of West Point became interested in extending the improvement to Salt River, which can be done at a relatively small expense. When this is done the Reservation will be served by a continuous improved road from Louisville.

Existing Roadway.

Two existing secondary macadam roads lead off from the Old Dixie

and cross the New. One passes southwest through Tip Top to Gramhampton. It served to carry supplies to Indian Hill and the pumping station during construction. The other passes in a nearly parallel direction through Stithton and to Vine Grove. Part of this road was reconstructed and made a part of the Camp system.

There are a number of unimproved roads throughout the reservation, which have been great aids during construction of the Camp, but which will not be available as part of the regular Camp system to any great extent. Their use will probably be superseded by the construction of light railways leading from the various supply depots to the battery positions.

In Stithton four streets were improved and made a part of the Civic Center system.

The old earth roads were made available during camp construction by draining and filling frequently the worst holes with crushed rock. Wood mats and corduroys of old rails were also used. Despite the open winter of 1918-19 and the wet spring following, the transportation of materials and commissary supplies was successfully kept moving to the isolated sections by these primitive methods.

Temporary Roads.

A large amount of temporary construction was necessary to provide roads along unloading tracks. Excavations were made to grade with a Keystone Excavator. Light fills only were made. Gravel and crusher-run stone were laid on the surface without other preparation and lightly rolled, traffic being depended upon to do the rest. Temporary drainage was put in where necessary. These roads have stood up well, considering the extremely heavy traffic they were subjected to. Though not a part of the camp system proper, doubtless they will continue to be used long after the project is in operation.

Anticipating the arrival of overseas troops in March, 1919, two miles of temporary road surface were laid on newly constructed grades for permanent roads in and near the Aviation Field and the First and Fourth Brigades of the Camp. Crushed rock and coarse gravel were hastily spread, sometimes over brush and rail mats, wide enough to barely accommodate the traffic. Before final completion, the rails and brush were dug out, the rock surface deeply scarified and spread to proper widths and a new surface made. This work was necessarily quite costly. Much maintenance of the grades was also required, since several of the roads were subject to constant traffic during their con-

structions previous to the laying of the final surface.

Secondary Roads.

Secondary roads throughout the Camp were constructed with light grading, usually twenty feet wide between berms with a sixteen-foot water-bound macadam surface. Grades were limited to 10 per cent., though, for most part, they are less than 6 per cent. With the exception of three concrete culverts, corrugated iron pipes were used throughout for cross drainage.

These roads were used largely during their construction for transportation of materials for other utilities and buildings.

Before the placing of the final surface, traffic was blocked off and the rock foundation scarified. The shoulder work and ditching was then completed. Twelve miles of this type were laid with an average depth of seven inches. The resurfacing of the Old Dixie from Tioga to West Point was done in this manner, the base having been reconstructed in a few bad places.

Primary Roads.

Primary roads were constructed with heavier grading; fills often reaching above ten feet in depth. In no case were old road beds used.

Grades were reduced to 6 per cent. and generally below 5 per cent. All curves have radii greater than 300 feet. Roads were thirty feet wide on top between berms, in earth, and twenty-eight feet in side hill rock cuts.

New Dixie Highway.

The New Dixie Highway leaves the Old Dixie Highway near West Point, following the Illinois Central Railroad to the Fletcher Farm, where it makes a turn to the left through an almost complete semicircle and begins to climb the side of Muldraugh Hill for 5,000 feet on a 6 per cent. grade. Near the foot of this climb it passes under the high trestle of the I. C. R. R. between retaining walls built to protect the towers. After reaching the summit of this grade in a cut twenty feet deep it turns sharply to the right and crosses over the I. C. R. R. on Twin Caves Viaduct. It then turns southward to Muldraugh. Near Tip Top, it makes a sharp detour around the Kentucky Silica Company's sand pit, where it was also necessary to construct an underpass for hauling from the pit. The underpass has eight-foot span, ten feet high and is constructed of concrete.

Near the Camp Knox Passenger Depot it passes under the new railroad track and continues through

Stithton to the Old Dixie, 1 1-2 miles further south.

Six trial survey lines were run before the route on Muldraugh Hill was finally chosen.

New Dixie Construction.

Drilling for rock excavation began the last week of September, 1918, and the work continued by contract until December 21, 1918, when the work was continued by Government forces. As originally planned the pavement would be all on rock cut 40 feet wide. Because steam shovels were not available of sufficient reach to make the excavation in two casts, making the work consequently more costly than anticipated, the section was reduced March 10, 1919, and the alignment slightly changed. At present the larger shovel goes first, the smaller following with the clean-up.

Earth excavation for roads began on the Dixie 1-2 mile south of Stithton, August 15. Work on the other main roads followed, as fast as sub-contractors arrived.

Up to June 16, 1919, were built over 14 miles of roads, including these abandoned and temporary roads remaining in use within the Camp. On the Dixie 6.5 miles more were completed on the same date.

Materials Handled.

Over 400,000 cubic yards of earth and 16,500 cubic yards of rock have been moved in the building of these roads. Of these amounts approximately 250,000 cubic yards of earth and 7,000 cubic yards of rock had been moved prior to December 21, 1918.

The first concrete pavement was laid in September 1918 at the southern extremity of the Dixie Highway. On October 15, 1918, work began in the Q. M. Depot and on November 7, in the Fourth Brigade. Work also started at the northern extremity of the New Dixie, October, 1918.

Owing to the mildness of the weather, concreting continued with little interruption until December 20, at which time 98,950 square yards of surface had been placed. The concrete pavement is 7 inches deep in the center and 5 inches at the edges, except in the warehouse areas, where it is increased to a uniform depth of 8 inches.

Washed sand and gravel aggregates were not obtainable as fast as desired. Three local quarries were opened and crushed rock supplied to meet the deficiencies. On account of steel shortage, no reinforcing was used in concrete pavements. Expansion joints were placed at intervals of 27 1-2 feet.

Five-foot earth berms were banked against the concrete generally. In Stithton macadam shoulders

8 feet wide were placed on Main street and the new Dixie Ray street. At the closing of the work by the sub-contractors 98,950 square yards of concrete were laid, including areas between warehouses built as part of the highways.

The first asphalt macadam was laid by Government forces the third week of April on the Dixie between the Civic Center and the underpass. On account of cold and damp weather the work was temporarily delayed.

The grades were constructed with berms and slopes as originally planned for the concrete sections which they displaced.

Equipment.

For the heavy earth excavation required on all the main roads, steam shovels of 1-2 to 3-4 yard capacity were found very satisfactory. Trucks and 3-up teams with dump wagons were both used to haul dirt away, the latter proving the more satisfactory method.

On account of their lightness, work of the above shovels in rock excavation was not as efficient as desired. In April two Marions, a Model 71 and a Model 60 were secured and began operations in May. They are proving satisfactory.

Two Keystone excavators were used in street work in excavations up to 7 feet deep. Little work was required to shape up grades behind them. They proved very satisfactory machines in points of utility and economy.

Two elevating graders were also used. They operated satisfactorily on flat elevations where the excavated earth was hauled with 3-up teams to the grades near by. The topography of the roads locations did not permit their use in grade building from side ditch excavation.

The Fresno scrapers proved very economical and serviceable and were used extensively in grade building and side ditch work. They were operated with one 2-up team and for loading their use is recommended.

A Byers Auto Crane with a 1-2 yard clam shell bucket was used for unloading road material from cars. Being portable, it could be readily shifted from one yard to another a mile away as occasion required. This machine was used almost continuously from September 1, 1918. It unloads an average of three cars per day, at small cost.

A Lidgerwood portable derrick with track was also used for a short time for unloading from cars into a bin. It was retained by the owner who retired from the work in December, 1918.

A stiff leg derrick was also rigged out of equipment from a dismantled quarry for unloading cars, but its use was not entirely satisfactory.

A motor driven asphalt distributor was used for spreading asphalt. On some grades it was necessary to attach it to a roller to give increased speed in order to prevent too heavy pouring of asphalt. A horse-drawn distributor was also used to a limited extent. Only one side could be used at a time and its work was not satisfactory even then.

Three types of concrete mixers were used in paving work. The revolving spout mixer proved very satisfactory in speeding up work and in point of economy.

Trucks were used extensively for all kinds of hauling; practically all of the local quarry output was hauled in this way. Their work was not altogether satisfactory when used for grade building on account of delays occasioned by their being frequently stuck in the grade.

Rented trucks gave better service than Government owned, and under most conditions were more economical than team hauling.

RAILROADS.

Length of Track Constructed.

The authorization for the construction of Camp Knox provided for permanent railroads into the Quartermaster area including the magazines, flying field, and power house for the hospital. A considerable mileage in addition was built to accommodate construction and wherever possible these construction tracks were so located that they might be left for the permanent operation of the Camp.

At the time the Camp started the railroad facilities at Camp Knox consisted of a single main line track of the Illinois Central which ran through the Camp in a north and south direction with a siding 2205 feet long at the town of Stithon. It was quickly realized that in order to accommodate the immense influx of cars large temporary facilities must be constructed.

The total length of authorized construction, including both permanent and temporary tracks was 12.5 miles. The first temporary track

was laid through the area now occupied by the Quartermaster Yard but was not in the position of the permanent tracks because of topographical reasons and the necessity of forcing it through very quickly. This track 2174 feet long, has since been dismantled. Other track which has since been removed was in the First Brigade, which with the above track made a total of 1.32 miles removed. In addition to this there is 0.23 miles of track including both the permanent track in the Quartermaster, hospital and flying field areas together with the temporary track in the Brigades, which will without question be used as permanent track.

Construction Details.

The material furnished consisted of rails originally rolled for the Russian Government, 67.53 and 80 lbs. per yard respectively and necessary fasteners for same. The ties were oak and pine. All track work was standard gauge; all switches No. 8 frogs but all main line connections were constructed by the Illinois Central Railroad on No. 10 frogs. The ballast used was cinders, Illinois Central Railroad Company pit gravel and crushed stone. All curves are tie-plated every other tie and cross ties spaced 54 per hundred feet. Earth bumpers are used at the end of all spur tracks. Total grading amounts to 71,392 cu. yds. and was done entirely by team and wheeler equipment except in the Quartermaster Yards, where it was handled by Thew shovels, elevating graders and wagons. Drainage was taken care of by corrugated iron pipe and wood box culverts.

Relocation of Illinois Central.

Extensive improvements were made by the Illinois Central Railroad consisting of a five track classification yard south of the Quartermaster area and a new terminal including a complete depot, power house for same and all appliances. The line through the camp was relocated so as to give a site available for the enlarged terminal and to

The following is a tabulation of the mileage grade and curvature of the various tracks:

Location	Perma- nent	Tempo- rary	Total Laid	Removed	In Place	Max. Grade	Max. Curvature
Brigade 1	—	10.393	10.393	3.193	7.200	3.00	14°-00'
Brigade 3	—	5.597	5.597	—	5.597	2.00	10°-30'
Brigade 4	—	5.085	5.085	—	5.085	2.00	10°-00'
Brigade 5	—	1.038	1.038	—	1.038	2.00	10°-00'
Q. M. Yard	18.439	4.400	22.839	3.174	19.665	0.56	9°-30'
Ordnance	.921	—	.921	—	.921	0.56	9°-30'
Aviation	.950	—	.950	—	.950	0.00	9°-30'
Hospital	1.942	.705	2.647	.705	1.942	2.00	10°-00'
Magazine	4.664	—	4.664	—	4.664	1.60	10°-00'
Totals	26.916	27.218	54.134	7.072	47.062	3.00	14°-00'

eliminate curves and grades. Advantage was taken of this relocation to put the main highways through by undercrossings avoiding grade crossings on the main line in the cantonment area. A "Y" was also provided by the Railroad Company for turning their trains and engines by building in a second branch of the turn-out into the Third Brigade. The old main line is still used as a switching line thus giving additional storage and switching capacity.

TEMPORARY WATER SUPPLY.

The securing of an adequate water supply for construction purposes was a serious problem, the camp being located, as previously stated, upon the divide and there was no supply available in the immediate neighborhood outside of a few small springs and wells.

The nearest adequate supply was located at McCracken Springs on Otter Creek at Grahampton, four miles west of Stithton. There is a hill called Indian Hill almost on a direct line between Grahampton and Stithton located one mile east of Grahampton, which is 200 feet in elevation above the Camp site and with an excellent site for reservoir purposes. It was planned to install a temporary water supply of 1,000,000 gallons capacity per 24 hours from this source.

Steam Driven Station.

A complete steam driven pumping station with duplicate pumping machinery and boilers to take care of breakdowns and emergencies was constructed at McCracken Springs. Two wooden tanks with capacity of 400,000 gallons storage were constructed on Indian Hill and an 8 inch wrought iron main was laid on the surface of the ground from the pumping station to the reservoir and thence to the various section of the Camp, involving the construction of approximately 10 miles of temporary water mains for construction purposes. It was impossible to complete this work until early in September but in the meantime water for construction purposes was brought into the Camp in tank cars over the Illinois Central Railroad and then treated with liquid chlorine and pumped into small temporary tanks and the distributing systems covered the area under construction.

The construction work was so carried out that the distributing mains through the brigades areas under construction could be completed before cold weather so that the temporary system of pipes on the surface of the ground could be abandoned with the exception of the force mains from McCracken Springs to the reservoir on Indian Hill and

the main connecting the line from same to the foot of Indian Hill. These mains had to be kept in operation pending the construction of the filter plant and pumping stations and were therefore covered to prevent freezing. The distributing system was substantially completed according to this program by December 31, 1918.

PERMANENT WATER SUPPLY.

General Description.

The entire camp receives its water supply from Otter Creek, the minimum flow of which has been weired and estimated to be six cubic feet per second and the maximum flow 18,000 cubic feet per second. Water is taken from this stream at its junction with McCracken Springs Branch, pumped to the filter plant and from there boosted to tanks located on Indian Hill. From this point it flows by gravity to the camp.

The water supply system was originally planned for a total capacity of 4,000,000 gallons per twenty-four hours. This was reduced on the curtailed program to 2,000,000 gallons per twenty-four hours and was effected by reducing the pumping capacity at the Otter Creek pumping station and at the filter plant. The filtering capacity was also reduced as well as the storage capacity on Indian Hill, wood tanks of 800,000 gallons total capacity being substituted for two concrete reservoirs, which were to have a total capacity of 2,600,000 gallons.

Otter Creek Pumping Station and Dam.

At the junction of McCracken Springs Branch and Otter Creek a concrete intake dam and pumping station were built, the minimum flow of Otter Creek at this point being adequate to supply the maximum demands of the camp. A small concrete dam was built to form a suction pool. The water is passed through a screen chamber into the suction pit of the pumping station.

The pumping station is equipped with two Worthington centrifugal pumps six inch two-stage, 1,000 G. P. M. 230 feet total head, each pump direct connected to a 100 H.P. Allis-Chalmers squirrel cage induction motor, operated at 1,500 R. P. M. by alternating current at 440 volts, three phase, 60 cycle. To provide for a breakdown in the electric system, one Allis-Chalmers centrifugal pump six inch, three stage, 1,000 G. P. M., 212 feet head, was installed, direct connected to a 6x6 Van-Blerk 100 H. P. gasoline engine. The three pumps draw their supply

from a suction well, discharge into a discharge header valved in a manner as to guard against the cutting off of the water supply through a breakdown of any of the units.

Priming facilities are provided by an electrically operated Nash-Hydro turbine vacuum pump. A water jet pump is also provided for priming pumps in case of a breakdown in the electric system.

The Filter Plant.

The normal flow line in the suction chamber and dam is 512 feet above sea level. The water is pumped direct to the two settling tanks at the filter plant, having a capacity of 200,000 gallons each with the flow line at Elev. 711.50; the water being pumped through two sixteen-inch rising mains cross-connected so that the entire flow can pass through either main in case of a breakdown. The total length of each rising main between the Otter Creek pumping station and the filter plant is 4,150 feet.

Coagulant is fed just before entering the settling tanks from coagulant tanks located in the filter room; two twelve-inch venturi meters located in the rising mains giving automatic control to the coagulant orifice boxes connected adjacent to the coagulant tanks.

The circulating piping to the settling tanks, and from the settling tanks to the filters, is duplicated to prevent a complete breakdown in the water supply. Every means has been provided to produce facilities for continuous operation.

Water flows by gravitation from the settling tanks to four half-million gallon filters in the filter house. The filtering and coagulant equipment was furnished by the Pittsburg Filter Company, Oil City, Pa., and embodies many features of a modern filter plant. Filter tubs are of the wood-tank rapid-sand type. The filtered water flows directly to the clear water basin underneath the filters, which is of concrete construction throughout and completely sealed from any contamination from outside sources. Capacity of clear well, 200,000 gallons.

Booster Pumping Station.

The booster pumping station is located adjacent to the filter plant and is equipped with two six-inch two-stage Worthington centrifugal pumps, 1,000 R. P. M., 230 feet total head, each pump direct connected to a 100 H. P. Allis-Chalmers squirrel cage induction motor, operated at 1,900 R. P. M. by alternating current at 440 volts, three phase, 60 cycle. To provide for a breakdown in the electric system one six-inch three stage Allis-Chalmers centrifugal pump 1,000

G. P. M., 200 feet head was installed direct connected to a 6x6 Van-Blerk H. P. gasoline engine. Filters are washed through the means of a Lee Courtney Co. ten-inch centrifugal pump, single stage, 3,000 G. P. M., 50 feet head, direct connected to a 50 H. P. Allis-Chalmers induction motor, operated by alternating current at 440 volts, three phase, 60 cycle at 1,200 RPM; the suction of the wash pump being connected to the clear water basin. Filters are being washed at the rate of two feet per minute vertical rise of wash water over the entire filtering area. No means were required for priming pumps at this station as the flow line of the filtered water basin is above the pump. Water is pumped from a normal elevation of 698, through two 16 inch wood rising mains to the storage tanks on Indian Hill. The distance from the filter plant to storage tanks is 3250 feet.

Wooden Storage Tanks.

Four wood tanks were constructed on Indian Hill for water storage of 200,000 gallons capacity each; maximum flow line at elevation 880. Piping adjacent to storage tanks are valved so that any one of the tanks can be supplied by one or both of the rising mains and water can be supplied to one or both of the gravity mains leading to the Camp. Tanks are covered and screened to minimize algae growth and prevent the water from becoming contaminated by birds.

Distribution System.

The entire Camp is supplied from the Indian Hill storage tanks through two 16 inch wood gravity mains. The distribution system was designed and constructed to provide for six brigades, Officers Training School, Hospital territory, Q. M. Depot, Artillery Park, Remount Station and Labor Battalion.

All the main feeders having been constructed before the curtailed program brought about by the signing of the Armistice in November 1918 was adopted, the grid system as originally designed for the six brigades constructed with the exception of branch lines that were eliminated through the curtailing construction order. The system was designed to maintain not less than 60 pounds nor more than 85 pounds in any part of the Camp; entire Camp being provided with grid system, cross connected and valved at all points to provide for any breakdown that may occur in the future.

The sizes and lengths of pipe in rising and gravity mains and distribution system are shown in table on the following page

Table showing sizes and lengths of pipe in rising and gravity mains and distribution system.

16"	Wood	300 ft head	20,192	lin feet
16"	"	200 " "	19,037	" "
12"	"	200 " "	20,999	" "
10"	"	200 " "	32,015	" "
8"	"	200 " "	67,053	" "
6"	"	200 " "	20,122	" "
4"	Cast Iron Pipe	200 ft	816	" "
Total			174,234	" "

—33.0 Miles.

The entire grid system in the Camp was constructed to provide for a total population of 53,580 and 17,500 horses. The domestic consumption was estimated at 55 gallons per capita; maximum domestic demand was taken at 156 gallons per capita for one hour's duration. Fire service demand was assumed at 2000 gallons per minute at the most distant part of the system from the storage tanks, plus one-fourth the domestic peak load.

Capacity of System.

The system is capable of supplying the Camp at the rate of 8,600,000 gallons per day. All valves are provided with roadway boxes. All specials, valves and hydrants were leaded by the use of accurately turned poured plugs. This work was done in the storage yards before being delivered to the point of installation. The entire system was laid in trenches with 30 inches cover. Every precaution was taken to prevent joints from blowing apart by the installation of concrete piers at every connection on short radius bends and with concrete anchorage on all vertical curves.

Service Pipes.

Service pipes to buildings are $\frac{3}{4}$ inches to 2 inches galvanized pipe tapped into wood mains with corporation cocks, this being the typical method of construction over the entire camp, with the exception of the Third Brigade in which all service lines were provided with goose neck between the corporation cocks and the service lines, each pipe having a stop and waste valve with curb box located near the buildings. All rising pipes from 30 inches below surface of ground to floor line of buildings are provided with frost proof wool felt covering, water-proofed on the outside with roofing paper.

Construction Details.

Considerable difficulty was encountered in the building of the Otter Creek dam and pumping station, due to the frequent floods which washed away sheet piling and coffer-dam, requiring rebuilding quite

a number of times, before the work could be completed.

Large quantities of limestone rock were encountered in trenching for mains from the Otter Creek pumping station to near the top of Indian Hill. At these points trenching had to be done by blasting, as all pipes were laid in rock formation. The rock on the top of Indian Hill is of a soft sand-stone composition, being quite hard before it is exposed. Trenches had to be dug to a depth of 16 feet and during the long period of time required for the installation of the pipe and period of testing, this rock would disintegrate, crumble and constantly cave into the trenches, causing a great deal of re-excavation. In some localities there was not sufficient earth to cover the pipes; all piping being required to have 12 inches of earth cover before any rock was placed in the trenches.

Sink Holes Cause Trouble.

Quite a number of sink holes between the Otter Creek pumping station and the top of Indian Hill were encountered. These sink holes were carefully avoided in laying out the right-of-way as it was feared that if a break occurred in one of the sink holes it would be impossible to repair the main, owing to its submergence. The sink holes would require pumping as there is no means of egress for the water except by slow percolation through the limestone formation underneath the sink hole.

One of the most serious difficulties encountered in laying the pipe mains throughout the entire camp was the length of time required to expand the mains with water. This caused the trenches to be left open for a long period and due to the numerous storms and rainfall that have occurred at Camp from the early fall of 1918 to the time of the completion a great deal of work had to be performed in preventing the wood mains from floating out of the trenches. Almost every line had to be anchored temporarily with cross bracing until the mains were tested, made tight and back filled.

Pumps were started in both the pumping station and filter plant on June 13, 1919, and took over the entire load on June 27, 1919.

SEWERAGE SYSTEM.

A complete sanitary sewerage system was planned for the entire camp. The section west of the Illinois Central Railroad, which lies on the watershed of Otter Creek, was designed to be collected at a pumping station and then pumped across the railroad to the system on the east side, whence it would flow by gravity through this system to Mill

Creek, a tributary of Salt River. As Mill Creek and Salt River discharge into the Ohio River, which is already polluted with the untreated sewage from Louisville and as the district through which the small streams flow will be largely abandoned since they will be used as a part of the Firing Range it was decided that it would be unnecessary to treat the sewage.

The program for the construction of the sewers was laid out to complete as much as possible of the main outfall sewer and the lateral sewers in the section under construction east of the railroad. Slow progress was made on the outfall sewer but the lateral system in the brigades at the northeast end of the Camp and immediately east of the railroad was completed by December 31, 1918, and placed in operation by connecting to a cavernous formation at a low spot at the east end of this section and treated with liquid chlorine. This permitted the sewerage system to be used by the troops which moved in from West Point.

Due to the retrenchment program, the sewage pumping station was diminished in size and capacity, and was arranged to handle the sewage from one brigade. Hospital Group, Artillery Park and two regiments of the Officers Training School.

Description of Pumping Station.

The station consists of a screen chamber, suction chamber and pump room, including pump pit. The station was completed and placed in operation May 23, 1919. It is equipped with one 6 inch single stage centrifugal pump built by the Hill Pump Works of the Mid-West Engine Company, Anderson, Ind. This pump is directly connected to a 50-H. P. General-Electric Company squirrel cage induction A. C. motor, 440 volts, three phase, 60 cycle, 1740 R. P. M., equipped with float switch for automatic operation.

To assure operation of the pumping station during possible breakdowns in the electrical system one 6 inch single stage Hill centrifugal pump was installed, belt connected to a 50 H. P. Fairbanks-Morse type "Y" oil engine operated at 257 R. P. M., pump running at 1200 R. P. M.

The pumps are connected to the suction chamber by means of cast iron pipe and discharge through a common header branching into the two 16 inch wood force mains immediately after leaving the station. The total length of each main is 1736 feet. The total head under which the pumps are operated is 58 feet, each pump having a capacity of 1,500 gallons per minute.

ELECTRICAL SYSTEM.

The electrical work at Camp Knox may be divided into three parts:

The Transmission Line, which supplies the Camp with electric energy.

The Camp Distribution System of Primary and Secondary feeders, together with their local transformers.

The Inside Wiring of the buildings.

Transmission Line.

The transmission line carries current to the Camp from the Waterside Power Plant of the Louisville Gas and Electric Company, Louisville, to Camp Knox, a distance of approximately thirty miles. The Service Company supply two distinct sets of three-wire feeders from their plant to a step-up substation on the Seventh street road in the outskirts of Louisville. On these feeders they transmit three phase electric current at a frequency of sixty cycles and a pressure of 13,200 volts.

This substation is of the outdoor type, containing electrolytic lightning arresters, choke coils, disconnect switches and the necessary bare copper bus bars, all suitably mounted on steel towers, together with master oil switches. At this point there are located three one thousand K. V. A. transformers, which raise the voltage from 13,200 to 33,000 volts, at which pressure the current starts out on the transmission line to Camp Knox.

Description of Construction.

The transmission line, as originally planned, consisted of a double three phase three-wire line to the Camp. After the armistice was signed and the Camp cut down to its present size, the authorities at Washington decided to erect only one line, or three wires except at the Kosmosdale cement works and at the crossing of Salt River, where the double line, or six wires, are strung.

On the top side of the poles, secured by a through bolt and three bolt clamps, the aerial ground wire of $\frac{3}{4}$ -inch galvanized steel strand is strung. This aerial wire is grounded at every fifth pole.

The transmission line consists of three No. 3 hard drawn stranded bare copper wires, supported on large porcelain insulators held by steel pins to treated wooden cross arms, which are secured to forty foot, or taller, cedar poles.

Typical Pole Equipment.

The poles are all equipped with a short top cross arm six feet long, secured about three feet, six inches

from the top of the pole. This arm has two insulators each approximately thirty-two inches from the center of the pole. The lower arm is secured three feet below the top arm. It is an eleven foot cross arm and contains four insulators thirty-six inches spacing, except the pole insulators, which are twenty-six inches from the center of the pole. It is braced by 2"x2"x $\frac{1}{4}$ " angle braces. The top cross arm is braced by 28-inch flat steel braces.

The cross arms were arranged for carrying a circuit of three wires on each side of the pole, and in order to continue balance of the spacing on the cross arms and poles, the one circuit that has been installed has utilized the two outside top pins and one pin on the lower arm. The transmission line throughout its entire length is guyed and properly sectionalized every mile.

From the substation in Louisville to the Camp substation the wires have four complete barrel transpositions; these transpositions are rolled left over right at certain points, as recommended by the Cumberland Telephone Company, to eliminate interference with their system, as we parallel them at certain points throughout the route.

The Camp Substation.

The transmission line is brought to the substation and distribution switchboard house of the Camp along the outskirts of the Second Brigade area. The Camp substation is similar to the Louisville substation, containing the necessary electrolytic lightning arresters, choke coils, disconnect switches and master oil switch and three 1,000 K. V. A. single phase transformer of 33,000 volt primary and 4,000 volt secondary. The primary of these is connected in delta and the secondary is Y connected, giving a neutral wire which we carry throughout the Camp. This gives 4,000 volts between phases and 2,300 volts between the neutral and any phase wire.

The distribution house is a fire-proof brick building, one story high with concrete roof. In this house the four wire three phase feeders from the transformers are connected to the four panel marine finish marble switchboard. The switchboard contains oil switches controlling six circuits, two for power and four for light. The circuits are arranged and space is provided so that feeder regulators can be later installed if found advisable. Just before the Camp feeders leave the substation each wire of each circuit is equipped with lightning arrestors and choke coils.

Camp Distribution System.

The Camp distribution system commences at the switchboard

house. One feeder of four No. 1 B. & S. gauge stranded weather-proof wire supplies the first and third brigades. One feeder, four No. 4 B. & S. gauge supplies the Fourth Brigade and the Quartermaster Warehouses. One lighting and power feeder, four No. 6 B. & S. gauge solid weather-proof wire supplies the Base Hospital area and Artillery Park. One lighting feeder of four No. 6 B. & S. gauge supplies the Civic Center. One power feeder of three No. 1/0 B. & S. gauge solid bare, and one No. 6 B. & S. gauge solid weather-proof, supplies the Filter Plant. This feeder supplies the pumping station at Otter Creek, using three No. 3 B. & S. gauge stranded bare and one No. 6 solid weather-proof wire. One power feeder of four No. 6 B. & S. gauge weather-proof supplies the sewage pumping station.

The feeders are carried on the main road of each brigade and branch laterals are taken off to supply single phase transformers from which secondary feeders are carried to the buildings. In each brigade the transformers are balanced as far as possible so that each phase supplies approximately the same kilowatts. The outside wiring layout is in accordance with the Washington Standard Block Plan for the Camp.

Inside Wiring.

The inside wiring is mostly of the klet and tube variety, although in certain buildings, such as warehouses, storerooms, garages and the theater, the wires are all in conduit. The National Electric Code is the standard followed throughout the Camp, and this work was done in strict accordance with the plans furnished by Washington. In certain buildings concealed wires are eliminated and the wires run exposed on strips, in order to eliminate concealed wiring. In this exposed wiring two and three wire porcelain cleats are used throughout the work. Where wall switches were called for these were usually run, using a small piece of conduit, from the ceiling down to the switch or receptacle outlet, as required.

The buildings are wired for two wire 110 volts, or three wire 110-220 volt service, depending on the number of circuits in the building.

The panel boards for the inside wiring of the buildings were all made up on the work, using steel cutout box and porcelain switch-blocks arranged for Edison type plug fuses. For bus bar on the panel rubber covered wire was used.

Construction Details.

The electrical construction of Camp Knox commenced August 12, 1918, when the White City Electric

Company, Chicago, sub-contractors of John Griffiths & Son Company, arrived on the work.

At that time the Camp work, which was included in their contract, consisted only of the inside wiring of all the buildings, according to the general plans as furnished by Washington. Towards the last of September the White City Electric Company also secured the contract for outside distribution system, including all the overhead pole construction and street lighting in the Camp.

The Louisville Gas & Electric Company had secured the contract to sell electric current to the Camp and they were also authorized to proceed with the erection of a transmission line from Louisville to Camp Knox, including the two substations, as described.

Work Delayed by Lack of Materials.

Because of the demoralization of the markets the materials for construction was very slow in arriving and the inside wiring in Camp proceeded in a desultory fashion. In fact, Washington finally authorized the contractor to make local purchases of necessary materials for three days' supply, and it was a continual operation of running out of material, ordering more and notifying Washington to cancel on the regular purchase order for the Camp.

About the last of November the material for this work began to arrive in bulk and the buildings were going up fast.

On December 21, 1918, the White City Electric Company had completed about forty-eight per cent. of the inside wiring of the reduced Camp program. They had done about 9 per cent. of the outside Campwork of the present authorized reduced area.

Period of Purchase and Hire.

On January 1, 1919, the Constructing Quartermaster organized an Electrical Construction Department. This Department completed the inside wiring of the Camp, except the Liberty Theater and Incinerating Plant. They had completed the outside wiring of the Camp, except the First Brigade, which was eighty per cent. poled and some extra wiring in the Civic Center, the service line to the Incinerating Plant, when work stopped.

In addition, the Constructing Quartermaster's Electrical Department took over from the Louisville Gas & Electric Company and built complete the last eleven miles of the High Tension Line from Louisville, including the Camp substation and switchboard house. The line

built by the Government force was extended from Salt River into Camp.

It was about 3:08 p. m. May 15, 1919, when the current from Louisville Gas and Electric Co. was officially turned on and continuous service from Louisville supplied to the camp.

The occupied area in camp was connected to this service and the leads from the Temporary Power Plant removed soon as possible and all wiring made permanent.

TRANSFER OF BUILDINGS.

Because of the number of buildings constructed and real estate properties purchased it was found necessary to organize a separate department, whose sole reason for existing was that the routine of transferring construction and real estate to the camp authorities might be carried out in accordance with Army Regulations. The duties of this department were:

- (1) Final inspection of all construction for deficiencies.
- (2) Final inspection of all real estate to determine improvements.
- (3) Paper work of transferring construction and real estate.
- (4) Disposition of temporary construction and real estate improvements which are not of military value.

HEATING—Base Hospital.

Type of System.

The circulation of steam throughout the entire group of hospital buildings is accomplished by means of a two pipe gravity system circulation, all water of condensation being returned to the boiler house by gravity, through an underground system of return mains in trenches. The supply main for each building is taken off of the main high pressure distributing lines through a pressure reducing valve placed inside each building. The ends of supply mains and the radiator returns are connected into a common return main suspended for the most part below the first floor joists and the ends of these return mains are trapped through high pressure steam traps into the main underground return system.

High pressure steam traps with valved by-pass are installed for discharging water of condensation from buildings return main into main underground return system.

Radiation.

All building will be heated by direct radiation; the radiators being of the steam type with one pipe connections. All column radiators are

three column 38 inches high and wall radiators are made up of 5 or 7 sq. ft. sections. Each radiator is operated by one steam valve on the supply end. This valve is a ball joint union connection. All of the return main branches, drips, etc., exposed under the first floor are covered with one inch air cell sectional covering and all fittings with plastic asbestos cement of same thickness.

Auxiliary High Pressure Steam System.

The auxiliary high pressure steam line is carried under the first floor of the ward buildings and connections are made to all fixtures requiring high pressure steam. The heating supply for the Administration Building is taken off this main. All pipe used in connection with steam and return system is black iron pipe with cast iron fittings. Pipe pitches in direction of steam flow not less than one inch in 30 feet and all low points and ends of mains are dripped through high pressure traps into main underground return system. Drip piping is run from all high pressure steam traps and connected into main underground return system.

STEAM HEATING—Misc. Buildings.

There are fifty-four buildings in various brigades, artillery park, quartermaster depot, civic center and filter plant, which are heated by separate low pressure steam plants.

A total of 1,556 radiators are installed, containing 58,581 square feet radiation.

The system used throughout is a two-pipe gravity return system with one pipe connection to the radiators. In most cases the supply mains are carried overhead, on the ceiling for one-story buildings or on the first floor ceiling for the two-story buildings. Supply connections are taken off from the bottom of the mains for first-floor radiators and from tops of the mains for second-floor radiators. Supply mains pitch one foot to twenty feet in direction of the steam flow and are vented at the ends at all high points with No. 1 Hoffman Air Valves.

Return mains are in most cases carried dry and pitched back toward the boiler. These supply mains are carried along the base board exposed above the first floor wherever possible and where necessary to cross doorways or for other reasons the return main drops below first floor and is suspended from the first floor joists.

Sectional Boilers Used.

The boilers used throughout are cast iron sectional of various makes

and sizes. They are in every case set in basement rooms below the first floor and at such a depth that the lowest radiator is at least thirty inches above the water line. The return water of condensation flows back by gravity. The end of the return main is vented in the boiler room through a No. 1 Hoffman Air Valve just before it drops below the water line.

Radiation used throughout is cast iron floor type, three column thirty-eight inches high steam radiation with single valve connection made into one tapping at the bottom. The bottom tapping on opposite side is plugged. All of this radiation is Kewanee Manufacture slip nipple type. A small amount of wall radiation is used, particularly in the bakery, brigade school buildings and motor repair shop. This radiation is American Radiator Co. made up in seven or nine foot sections.

All radiators have air vent tapping on the end section and are provided with hand operated wood wheel handle air vent cocks of Hoffman Manufacturing Co. type.

The supply used on radiators are of the Crane, Ohio, or Jenkins manufacture and are provided with union connections. Both angle and gate types are used.

Headquarters Cottage, Third Brigade

This building does not have a steam plant of its own, but is supplied from the Third Brigade Headquarters Building. A two-inch supply and a two-inch return main are carried across under ground between the two buildings. The pipes pitch in opposite directions and are carried in separate iron pipe conduits. The steam and return pipe in the conduit is covered with air cell and wrapped with hair felt.

This building has a total of 300 square feet of radiation and this is carried as an extra load on the Headquarters Building boiler. The arrangement was made after the Headquarters Building plant had been figured and installed.

HEATING—Liberty Theatre.

The heating system provides low pressure steam distribution with gravity return lines connected to direct radiation. The ventilating system provides tempered fresh air by means of motor driven multiblade fan cast iron heating coils and ducts to special ventilators in the auditorium floor underneath the seats. All regulation is by hand control.

Boiler.

The boiler in the basement under the foyer is 150 H. P. return tubular steel boiler 72 inches in diameter by 18 feet long. The boiler is brick set and suspended. Steam is taken

off of boiler and carried in four branches, three of which supply direct radiation and one the indirect heating stacks. At no time should a pressure of more than 15 pounds be carried on this boiler.

Steam Supply Mains.

All steam supply mains are carried overhead with down feed risers. The branch main supplying radiation in foyer is separate and is carried in attic space. The supply mains for the radiation in front end of building not supplied by overhead main, is carried in the space below foyer floor. An automatic air valve is provided at ends of all supply mains, and all drop risers are dripped into return main after radiator connection is taken out.

Return Mains.

Return connection is made from the return end of every radiator throughout the building excepting those radiators in the front end of the building which are supplied from main below. The return main collects the return from each radiator, and the drips, and is carried underneath the main floor back into the boiler room and is connected directly into the boiler return header through gate and check valve.

Radiation.

Radiators are either of the cast iron column or wall type. Column radiators are of the Kewanee make and wall radiators are of the American Radiator Co. manufacture. All radiators are tapped on both supply and return end at the bottom and have air vent tapping on the return end section. All column radiators are of the steam pattern. There is a total of 5,185 square feet in the entire building, contained in sixty-one radiators.

Covering.

All main steam and return piping, except supply drops to radiators where drops are in heated rooms, are covered with four-ply air cell sectional covering. This includes all pipes in boiler and fan room, and mains in and under the theater and front entrance.

The boiler is covered with 3-inch and all smoke pipe and breeching with 1½-inch magnesia cement plaster secured on galvanized expanded metal or galvanized iron wire netting with a finish coat containing a small amount of Portland cement troweled to a smooth finish.

Fan and Motor.

The ventilating fan is a full housed top horizontal discharge double inlet multiblade type, with a capacity of 30,000 C. F. M. when working against static pressure of not

over water guage. At this speed and air delivery the fan must not require over 12 B. H. P. peripheral velocity to be not over 3,200 feet per minute.

The above fan is operated by means of a 15 H. P. motor with slide rails, base and pulley. The motor is of the induction type wound for 3 phase 60 cycle, 3 wire, 220 volt current and is started by step speed controller.

Heating Coils.

The fan discharges the air through a set of heating coils consisting of six sections of C. I. Vento radiation set on piers and arranged two wide and three deep in the direction of the air flow. The metal air stop around and under the Vento is provided with two-dampened openings. Dampers are hand operated and may be used in conjunction with the steam supply valves for regulating the temperature of the air in the Plenum chamber.

The four sections of Vento nearest the fan outlet are provided with steam, which is regulated by means of 1-inch gate valve placed inside the boiler room. The other two sections forming the outer face of the heating coils are regulated by means of a gate valve placed in the boiler room. By manipulating these two valves, one-third or two-thirds or all the heating surface may be utilized at any time. There is approximately a total of 1,200 square feet of radiation contained in the six sections of Vento.

Air Distribution.

The fresh air is taken into the fan suction from a fresh air shaft leading from the roof. A register is provided so that air may be drawn from the auditorium near the floor into the fresh air shaft and two dampers are so arranged that all fresh air, recircuit air, or a mixture, may be taken into the fan. Galvanized iron ducts are taken from the Plenum chamber and carried underneath the auditorium through galvanized iron hoods located under the auditorium seats.

Three galvanized iron ventilators, located on the roof and opening into the auditorium, carry off the foul air. These ventilators are provided with dampers arranged with chains to operate from the floor.

ARRIVAL OF TROOPS.

There are two cantonments at Camp Knox, the temporary camp near West Point, Ky., and the permanent camp at Stinton. For convenience they will be called West Point and Camp Knox.

The 327th Regiment of Field Artillery arrived at West Point on April 6, 1918. The 325th and 326th

arrived in May, 1918. These regiments made up the Field Artillery Brigade of the 84th Division. Their training was completed the latter part of September, 1918, and their places at West Point were taken by the following units:

170th Brigade Field Artillery, composed of the 67th, 68th, 69th Regiments of Artillery 23rd and 26th Trench Mortar Batteries.

24th Brigade Field Artillery, composed of the 70th, 71st, 72nd Regiments of Artillery and the 24th Trench Mortar Battery.

29th Aero Squadron.

31st Balloon Company.

At Camp Knox a Labor Battalion of 500 men and a Military Police and Fire Company of 200 arrived on September 22, 1918. The Labor Battalion was increased to 1,100 within a month.

All military units considered there were on the Knox Reservation, approximately 12,000 men at the date of signing of the armistice.

The first troops were transferred from West Point to Camp Knox on November 24, 1918, and consisted of the 170th Field Artillery Brigade, comprising about four thousand men under the command of Brigadier General Charles S. Blakely. Some time prior to their arrival, approximately the 1st of

November, the Camp Quartermaster with a detachment began storing commissary and equipment supplies and from that date on have been constantly receiving these shipments.

The Medical, Ordnance and Motor Transport detachments arrived at various times between the first of November and December 15, 1918.

On December 26, 1918, the 24th Field Artillery Brigade, having approximately the same personnel as the 170th, under the command of Brigadier General Koester, was transferred. Very shortly after the Twenty-fourth Brigade arrived the 170th Brigade was mustered out.

Returned Overseas Troops Arrive.

The Eighth Brigade arrived from overseas on March 25, 1919, and shortly after this date the Twenty-fourth Brigade was mustered out of service. Soon after their arrival the Eighth Brigade discharged most of their personnel, maintaining only skeleton organizations.

The maximum number of troops at the permanent camp at any one time during the construction period was about nine thousand men. This occurred during the latter part of December, 1918.

ACCOUNTING.

The accounting was carried out in accordance with the Manual for Field Auditors, with the variations described below:

Timekeeping System.

It was found desirable to adopt a card in place of the brass check described in the Manual because of the large area over which the work was conducted, and the necessity of pro-

viding a system which would be flexible enough to allow the workman to check in and out at the checking station nearest his work. The card adopted is shown herewith:

No.	NAME	DATE
THIS CARD MUST BE FILLED OUT AND TURNED IN EACH DAY OR WORKMAN WILL RECEIVE NO TIME		
IN	OCCUPATION	HOURS WORKED
A. M. Field Check		
P. M. Field Check		
OUT		HOURS PAID
TRANSFERRED FROM DIV. — TO DIV. — TIME —		
APPROVED		SIGNED
TIMEKEEPER		FOREMAN

This card was issued to each person on checking in in the morning and was carried by him throughout the day. It was inspected during the course of the day by the time checkers with a punch, this mark indicating the individual checker. Before turning it into the office it was signed by the foreman and timekeeper for the particular gang in which the individual was working. It was turned in to the time keeping stations at quitting time by the individual to whom it was issued, and the Government inspector checked the card with the individual's button before acceptance. This card was also cleared with the foremen's reports, and together with the foremen's reports served as a basis for making up the pay-rolls and for checking shortage claims. It was found superior to the brass check inasmuch as it left a record of each day's work as well as showing that the individual had checked in in the regular way and was on the pay-roll for that day.

Central Pay Offs.

Pay offs were made weekly, the week ending Monday night, and the pay off at the cessation of work on Saturday. It was found desirable to use a central pay off station for paying off all groups which were accessible to it because of the large amount of cash to be handled, and because of the confusion which would arise due to the shifting of individuals if more than one station were used. This station was large enough so that the entire pay off could be made in approximately two hours, and by centralizing it the regular office force was used without the addition of special pay roll clerks. At some far away points on the reservation it was found necessary to take the money to the groups, but this was the exception rather than the rule, and they were brought to the central pay off station wherever possible to do so. All payments were made in cash, the money being put up in envelopes by Louisville banks, transported by express and delivered to the pay off station under guard.

Purchasing.

It was found necessary to organize a purchasing department on a large scale because of the large number of small purchases required for the commissary. This was particularly true under the period of purchase and hire, and the purchasing agent was constantly in touch with the Louisville market. By being on the ground, and by being properly organized, advantage was taken of any fresh supplies which were in the market, or any special lots of materials which could be had at reduced prices. A considerable amount was saved in this way rather than by buying under the regular con-

tract form of the army. All emergency purchases were carefully scrutinized and authorized by a member of the Constructing Quartermaster's commissioned staff. Due to this organization quick deliveries were secured for emergency purchases of building materials or equipment.

Post Property Accounting.

It was found desirable for the forces of the Field Auditor to make up Form 217 required in the Property Accounting from the paid money vouchers, instead of their being made by the organization of the Property Officer.

COST ENGINEERING.

The Cost Engineer furnished three regular weekly reports to the Supervising Constructing Quartermaster in Washington and such other regular and special reports as were desired by the Constructing Quartermaster, they covering all phases of the progress and current cost data. The taking of progress photos was also under his direction, showing special features of the work, or a continuous record of a few consecutive weeks any points where a progress was of special interest. Few photographs were taken after the work was changed from emergency construction to direct a purchase and hire basis.

Reports to Washington.

The weekly reports to Washington consisted of:

- (1) The "Plot Plan," which was a map showing all buildings and utilities shown by various conventional markings to indicate various stages of completion.
- (2) The "Weekly Progress Report" showing in figures the status of the project financially and as to physical progress.
- (3) "Unit Cost Cards" carrying unit cost to date and for the current week on each class of work in each type of building or utility included in the project.

Local Reports.

The regular reports which the Constructing Quartermaster desired were:

- (1) Comparative Cost Reports at as short regular intervals as possible.
 - (2) Graphical representations of progress along various lines, to show the lagging of any part of the work.
- Special reports were often required which had to be based on the same underlying data as the regular reports, but arranged in different combinations or given in more detail.

The greatest difficulty experienced by the Cost Engineer was in collect-

ing data in sufficient detail to permit its recapitulation and summarizing in all the different ways required by the various forms of reports.

Complexity of the Percentage of Physical Progress.

The first phase of this difficulty was the necessity of combining physical progress on over fifteen separate kinds of construction work, each comprising from five to forty different operations on which cost and progress were kept, to give rational and accurate estimate of the percentages of physical completion of various parts of the project and of the project as a whole at each report date. The project was divided into a number of separate authorizations with separate allotments of funds on which progress had to be reported separately. These authorizations, in turn, had to be subdivided according to the classes of work to be done under them, each comprising some or all of the following classes:

- (1) Building Construction.
- (2) Plumbing.
- (3) Interior Electric Wiring.
- (4) Stoves and Sheet Metal Work.
- (5) Kitchen Equipment.
- (6) Steam Heating.
- (7) Water Supply.
- (8) Sewerage.
- (9) Electric Distribution Lines.
- (10) Electric Supply.
- (11) Railroads and Trestles.
- (12) Roads and Walks.
- (13) General Grading.

In addition to the "Building Construction" on the largest authorization which covered the main cantonment had to be reported by type and size of buildings, thus dividing this class into about 100 groups of which seventy-five to eighty-five were under construction at one time. Besides this grouping for the regular report, it was necessary to recapitulate the data to get per cent of progress on various groups into which the cantonment was divided.

To meet these conditions the amount of work involved in the completion of each operation or class of work was expressed in terms of a common unit of measure, and the result called the "Total Labor Equivalent" of the operation. These could all be added, being in like terms, in any combination of parts required or in total for the entire project, to obtain bases for calculating percentages of progress of various parts of the work or groups of structures. The progress was calculated in terms of the same unit of measure to obtain the percentage ratio. The unit adopted here for calculating the "Labor Equivalent" was the "Normal Dollar's Worth of

Direct Labor," and the "Total Labor Equivalent" was thus an estimate of normal direct labor cost. Other units which could have been used are "Equivalent F. B. M." and "Man-hours." From the Cost Engineer's experience here he would in general favor the use of the "Man-hours" in preference to the other units, because it is fundamental, requires least calculations before comparison of the progress with the actual labor expended, and is independent of the questions of relative rates per day, and overtime pay. However, the "Normal Dollar Worth" is the next most satisfactory unit. It may be more easily established, and for a single project under uniform conditions gives rational and accurate results which are easily interpreted.

Application of the Plan Used.

In recording progress, the actual work done was extended by a list of unit prices, part of which were determined in the Washington office of the Construction Division and part by adjusting other known units of cost to fit the assumed rates of wages used. This procedure gave absolute quantitative records of progress and percentage records which in only a few cases showed marked variations not checking with actual work done. The quantitative records are always available for comparison with the total of the project as completed, as originally authorized, or as revised at any time, and for plotting of progress curves of any part or combination of parts of the work. Because of the great variety and scattered character of the work, the collection of comprehensive data for comparative costs from such a multiplicity of sources, and the summarization of them quickly enough to be of service in managing the work was accomplished with great difficulty. A daily report of comparative costs was first aimed at, but was finally given up as impractical because data could not be gathered and summarized quickly enough. It was also proposed at first to report comparative costs on each operation under the various classes of work. On the building construction this was found impractical because of the large variety of operations as represented by about forty subaccounts in the accounting system, and the frequent shifting of men from one operation to another.

The following is a typical statement of comparative costs of the work of two groups:

Group No. 1 does 550 units of labor equivalent for \$605.00 labor cost, making their rate $\frac{605}{550} = 1.10$

Group No. 2 does 430 units of labor equivalent for \$516.00 labor cost, making their rate $\frac{516}{430} = 1.20$

Gang No. 1 is shown to be working cheaper than Gang No. 2 in the ratio of 1.10 to 1.20. The smallest force of workers it was practical to compare in this way was found to be a group of gangs operating under one superintendent in a definite group of buildings. The period covered by the reports in this form was fixed at the half week. The semi-weekly reports were frequent enough to catch tendencies in the work on building construction, but on the construction of utilities this period was so short as to give some erratic results at times.

As a result of the above considerations the "Semi-weekly Comparative Cost Report" was developed in two parts; one covering building construction and the other the construction of utilities. The building report was in terms of "Labor Equivalent" and the utilities in terms of quantities handled.

"The Plot Plan Report," a standard progress map as required in "General Instructions for Constructing Quartermasters," was started immediately upon the beginning of construction and expanded as work progressed. It is the simplest form of progress report, but loses its effectiveness when the whole area is covered by work under way as the changes of conventional markings are not sensitive enough to indicate real progress. Thus it was found necessary to make a graphical representation of progress by curves and by lines and blocks of various magnitudes. It was difficult to make this available for current use because of the process of digestion which all data must go through before it is ready for such presentation and the mechanical work of delimitation.

After some experimenting, the following three forms of curve were adopted.

1st. Curves between "Labor Equivalent" in place to date and aggregate direct labor.

2nd. A curve between Total Labor Equivalent in Place and Time.

3rd. A diagram of Unit Cost per Unit of Labor Equivalent showing the current value and average to date.

Only these three could be shown for a special class of construction, but on the general chart for the project as a whole other features were added which applied to the whole, viz.: "Weather conditions," and curves of "Force Employed" and "Total Productive Man-hours Spent to Date" plotted along the Time Scale, also curves between aggregate Labor Equivalent Complete to Date and various parts of the cost to date as e. g. Total Productive Labor distinguished from general office work, oversight and rental of equipment. All of the above was included in Total Labor for which a curve was also drawn. See Exhibit G.

A study of these charts by graphical projection of the various curves would at any time indicate with reasonable accuracy the probable course of the work. The date of completion with any assumed force or the force required to complete by a given date could be forecast from the curves of Progress in Labor Equivalent and Productive Man-hours Spent to date. The cost to complete could be estimated from the Progress Cost Curves. The relation between amounts of work originally authorized and left to be done after various additions or deductions is readily shown by horizontal lines at various heights on the "Labor Equivalent" scale, either for the project as a whole or for any part or class of work treated separately. Having all the work reduced to the common terms of "Labor Equivalent" facilitated comparison of the relative quantity to be done in various lines at any time as a guide to keeping the organization balanced for proper relative progress.

COMMISSARY.

The commissary at Camp Knox was a million-dollar proposition and it is believed the experience derived therefrom is worth recording. In a general way the operation of commissary follows the construction work as it was operated by contract during the period of emergency construction and by the Government during the period of purchase and hire. The last named period was rich in operating experience and that part of the business was conducted with satisfactory results so far as service went and at a profit to the Government.

At the beginning of construction it became obvious that large numbers of men must be housed and fed in camp. The commissary was planned on a basis of 10,000 men per day. Because of the widespread area over which the work was conducted, the necessity of feeding the men close to their work, and the shifting of men as the work progressed it was necessary to provide a capacity very much larger than the actual number fed. Self-help table de hote service was adopted and used throughout the entire project.

The standard mess halls in the areas where large numbers were to be fed were H-shaped and were composed of a big central kitchen with four dining halls. To save construction four standard permanent mess halls were used and the only construction required being the central kitchen. It was expected to tear out these central kitchens and finish the four messes in accordance with standard plans before occupancy by troops. The ammunition train areas were chosen wherever possible as it was thought these

would be the last areas required by troops. This type of mess hall would easily feed 2,000 men per meal. Seven messes of this type were constructed and used. Three have been retained as built, one has the central kitchen converted into a garage, one has been revised to cut out two wings and two have the central kitchens torn out and the wings finished as individual company messes. The mess halls on the outlying districts were each subjected to individual study and designed in accordance with the requirements of the place. Nine of these small messes were operated at one time. In addition the commissary had to operate a canteen, restaurant and barber shop. Private operation of these necessary adjuncts was found unsatisfactory, and under Governmental operation they netted a substantial financial return to the Government. Under the period of purchase and hire an a la carte cafeteria and a short order mess were operated for the benefit of the office help.

Meal tickets were issued to workmen and deducted from the payroll. This was necessary because most of the common labor was not farseeing enough to keep sufficient cash to carry them between pay days.

The better grades of meat and provisions were found to be the most economical in the long run. Perishables were bought in the Louisville market, staples wherever they could be bought the cheapest.

A close check was kept on food issue particularly on such items as meat, bread and potatoes. One pound of meat, one-half pound of bread and one-half pound of potatoes were ample as a daily ration per man. Thievery could be detected with almost uncanny accuracy by a study of the issue on these three items, and the first move after a complaint of poor food from a mess was a call for a statistical report on the quantities which had been drawn by that particular mess hall.

During the period of purchase and hire it was found that the difference between profit and loss lay in the cost of overhead. There is great danger in operating large mess halls of over organization. The organization on paper may not seem unnecessarily large and every one has a definite duty, but it has been found that these duties may occupy only part of the individual's time, and expert management and constant watchfulness is necessary to see that the work is so organized that each employe is fully occupied in useful labor. This is particularly difficult because of the division of the day into three groups of intense work with lax periods between. Mess employes are notoriously inefficient if not properly managed. They must be constantly watched to see that they do not appropriate the best

food for their own use and feed their friends as well.

Meals were served for the first four months at thirty cents and the balance at thirty-five cents. An average meal consisted of generous portions of meat, potatoes, one vegetable, bread and butter, coffee and a dessert.

RECOMMENDATIONS.

Use of Second-Hand Equipment.

1. On a large project built under emergency conditions, it is believed that, while it is perhaps expedient to use second-hand rented equipment, it is not advantageous to the Government in the long run. The only advantage is that such equipment is quickly available. The disadvantages are that no schedule of rented prices for second-hand equipment can possibly cover the many grades and kinds of such equipment. It is furthermore exceedingly difficult to place an equitable valuation on second-hand equipment without observing it in action for a relatively long period of time. Second-hand equipment is notoriously able to go through all the motions of operation without actually producing the desired results. Then again, there is no standardization of make or design which causes costly and aggravating delays from breakdowns and the necessity of securing repair parts of obsolete types of equipment. It furthermore permits the practice of concealing the rightful owner. Where the owner is a third party it leads to many misunderstandings and claims frequently through the ignorance of Government methods by the rightful owner himself. It is believed on a large project of this kind that the standardization of type of equipment and the direct purchase of same from the manufacturer is economical.

Clearance of Warehouse Platforms.

2. It is recommended that the distance of six feet shown on the typical plans from center of track to edge of platform or warehouse or the nearest obstruction should be made to conform to the distance required by law, but not less than seven feet and preferably eight feet.

Use of Enlisted Labor.

3. It has been found by experience on this project that enlisted labor can be used successfully if it is entirely segregated from all civilian operations, and if the character of the work is such that the enlisted men take a personal interest in it. To this end the Labor Battalion should be officered with men who not only appreciate the value of labor in their charge, but also men who can keep up the interest of the personnel. It was found that when other methods were used, Labor Bat-

tallon labor became notoriously ineffective. It was also found that definite assignments must be made to non-commissioned officers, and they must be held personally responsible for the conduct of their particular piece of work; otherwise it would be slighted.

Locally Manufactured Materials.

4. Except in cases where profiteering is evident the use of such materials does not secure marked economy. This applies to concrete materials, posts, lumber, mill work and any other construction materials for which home-made substitutes may be utilized. The manufacturer of these materials operates ordinarily on a relatively small percentage of profit, and produces on a larger scale than that possible by local operations. Furthermore, the manufacture of home-made materials diverts labor which should be normally applied to construction work. For instance, it was thought advantageous on this project to operate quarries when it was difficult to secure adequate crushed stone, and while these quarries produced at approximately the same costs as commercial materials, their total output was so small as to be of no real benefit to the project.

Scheduling Dates of Completion Prior to Engineering Investigations.

5. This project has shown in many ways the importance of intensive engineering investigations of local conditions prior to actual construction and the impossibility of scheduling dates of completion by predicating the proposed accomplishment on past performances of other projects. This project happens to be in a very rough country, which had never been accurately surveyed, with inadequate roads, warehouses, and housing facilities for labor. If the emergency had not existed, and it had been feasible to have given the terrain an extensive engineering study prior to actual construction, large savings could have been made in engineering and overhead costs, the distribution of materials, the design and location of utilities and a schedule worked out which would have been possible of accomplishment under economical conditions. In other words, if all work could have been co-ordinated before actual construction began, the same results would have been accomplished in less time and at less expense.

In addition to the location of buildings and utilities, the big essential things to be studied prior to construction are roads, housing facilities, railroads, transportation and water supply. It was found on this project that the question of temporary water supply was particularly vital, and the inability to secure an adequate temporary supply tremen-

dously restricted the construction operations for the first thirty days. It was necessary to build an expensive temporary supply, which could not be incorporated in the permanent system, whereas prior engineering investigations would have made this feasible. The scheduling of dates of completion of utilities, such as water, sewers, electric lights, etc., should be such as to make their completion well in advance of the rest of the building program in order to give ample time for testing machinery and equipment. The tuning up of the various plants and operating devices of the utilities is very essential to the orderly and economical operation of the camp.

Gate Valves in Wood Mains.

6. Gate valves in wood water mains are recommended at a distance of not over 500 feet apart through areas where other construction work must be carried on. The additional cost of the installation will pay for itself many times over by the elimination of interference with other building operations. The usual methods of laying wood pipe requires long stretches of open ditches while the water mains are swelling under test, and these open ditches interfere with other construction operations. At one time on this project there were five miles of open water ditch.

Wooden Storage Tanks.

7. Wherever conditions will permit, concrete tanks for storing water are preferable to wood stave tanks. This applies to tanks located on elevated ground and not on towers. It has been found on this project exceedingly difficult to keep the wood storage tanks in water tight condition because of the variations in demand, and lack of water in the tank for two days is sufficient to cause serious injury to the tank and require extensive repair.

Property Accounting and Transfer of Construction.

8. The applications of the army system of property accounting and the transfer of property, completed construction and real estate on a large project of this kind results in a vast amount of detailed labor which would not be countenanced by a commercial organization. It is believed the existing regulations could be modified or amended to eliminate a large part of this expense. This is particularly true on purchase and hire work where we go through the motions of charging up the civilian heads of departments with any property which they may have had on the work, and where it is necessary to take up as property subsistence supplies which are to be expended almost immediately in the mess

halls. Again in transferring completed construction or real estate, each responsible officer insists on his own inspection of the property in question. This results in confusion and a duplication of work which could be eliminated. At present each building must be made on an individual transfer and all property and equipment contained therein is subject to the inspection and check of each officer through whose hands it passes.

Overtime.

The Constructing Quartermaster has always held that overtime and Sunday work were of no value in the advancement of work where the overtime and Sunday work covers an extended period of time. A man is good for a given number of foot-pounds of work per week regardless of the number of hours of overtime he puts in. Unfortunately it was expedient to put in the overtime prior to the signing of the armistice, as practically all other projects were working overtime and it was impossible to get the labor otherwise. The eight-hour day is therefore recommended for all Government work, whether under emergency conditions or not, and provided the construction covers an extended period of time. At the same time a means should be provided for overtime for short periods and the Constructing Quartermaster would not hesitate to recommend overtime in small doses where something can be gained by so doing. The proper place for overtime is to save life and property and to effect economies by equalizing the construction program.

Civil Service Employees.

It is believed the Civil Service rules should be revised to permit of more flexibility in the hire and separation of temporary salaried employees, particularly where technical knowledge or skill is required. This statement is based on mature consideration of the experience gained during the period of purchase and hire when large numbers of salaried employees were required. Under the caption of "Labor" the application of the Civil Service to hourly wage employees was discussed and the service generally recommended. Likewise it is believed a discussion of the case of salaried employees is pertinent, and in order that a full and complete statement may be of record.

A construction organization is not a fixed machine like a manufacturing business. It is a process of constant integration and reorganization. To successfully compete with commercial organizations the brain workers must have an esprit de corps which only comes through pride of organization and recognition by the chief. Likewise the

chief must carry the responsibilities of completion of the work in hand according to program and the cost of its production. In other words, power and responsibility must both be centered in the head of the business in order to produce results. The rules of the Civil Service which require prior authority before hiring, or increasing rates and the academic judgment of the value of employees by an absentee official based on the previous two years earning capacity are the things which make it exceedingly difficult to operate a construction force of temporary employees with any degree of real economy. The application of these rules discriminate against the man of large ability and provide a means for putting in his place a number of men of smaller ability, a condition which cannot make for real service.

The situation might be expressed in this way, the Constructing Quartermaster carries the necessary responsibility, but has not the power to reward or recognize exceptional service.

Exhibit A.

REPORT OF SITE FOR TWO BRIGADE CAMP.

May 25, 1918.

TO: Construction Division, Engineering Branch. Attention: Maj. Gibbs.
FROM: F. B. Smith, Captain, Q. M. R. C.

SUBJECT: Site for Cantonment or Tentage Camp for Two Brigades of Artillery near West Point, Kentucky.

Pursuant to order dated May 18, 1918, I proceeded to Camp Taylor and thence to West Point, Kentucky, to secure data to assist in the estimating of the cost of a cantonment or camp for two brigades of artillery at West point. Request for such estimates was made in the memorandum from Brigadier General Jervay, Director of Operations, dated May 9, 1918. Before leaving for West Point, I called at the office of the Chief of Field Artillery in the State, War and Navy Building. There I was requested to meet at West Point and to consult with Lieut. Colonel Blakely and Lieut. Colonel Corey, the latter being in command of a tent camp where there are already in camp one regiment and one battalion, together with certain student officers from the Field Artillery Brigade at Camp Taylor. The Office of the Chief of Field Artillery informed me that it was considered that there were two available camp sites on the area which they have recommended should be leased. One of these camp sites was described as in the vicinity of Stithton, Kentucky, adjacent to the Illinois Central Railroad and the other site just southwest of the town of West Point, south of the Louisville, Henderson and St. Louis Railroad and west of the Illinois Central Railroad.

At the suggestion of Lieut. Colonel Chamberlain, the Constructing Quartermaster at Camp Taylor, Major Gilbert was requested to go with me to West Point. Accompanying us was also Mr. W. S. Shields, of the Hartford Building, Chicago. Mr. Shields is an employee of the Construction Division at the Jeffersonville Quartermaster Interior Depot and was loaned to the Engineering Branch for the purpose of making a report on the water supply situation for the proposed camp at West Point. He is making his report directly to the Construction Division, attention of Lt. Colonel Maury of the Engineering Branch. With Major Gilbert we first visited the existing tent camp location which is shown on one of the maps

accompanying this report and which is marked Exhibit "A." A larger scale and more detailed topographic map of the existing camp site also accompanies this report and is marked Exhibit "B". A plan showing the layout of the camp accompanies this and is marked Exhibit "C". (None of these maps are reproduced.)

At the camp we met Lt. Colonel Corey in command there. Lt. Colonel Allen, a Sanitary Officer at Camp Taylor, Captain McCoy, Sanitary Officer at West Point and Lt. Colonel Blakely of the Field Artillery. The last officer was asked by the office of the Chief Field Artillery to meet me at West Point in order that we might confer upon the subject of the location of the camp, and its relation to the artillery range. Lt. Colonel Allen was at West Point, by order of General Hale, Commanding Officer, Camp Taylor, to make a sanitary report upon the proposed camp site.

The land at present under lease lies south of the village at West Point, east of Salt River and west of the Louisville and Nashville Pike. A topographic map of this area which is primarily suitable for and used as an Artillery Range, but which has some land suitable for the purpose of a camp accompanies this report and is marked Exhibit "D". (Not reproduced.) The area which it has been proposed should be leased also includes all that land to the west of the present area and south of the Ohio River as shown on the accompanying map marked Exhibit "E", which map is a print of a map loaned to the Construction Division by the office of the Chief of Field Artillery and stated by them to have accompanied the report of Brigadier General McIntyre, who, some months ago, was in command of the Artillery Brigade at Camp Taylor, and has since been transferred.

As heretofore stated, the office of the Chief of Field Artillery considered that there was available in the entire area two camp sites, one in the lowland, south of the L. H. and St. L. R. R. and back from the Ohio River about 4000 feet. This area is marked (1) on the map called Exhibit "E". The second available camp site was stated to be adjacent on the north to the town of Stithton which lies on the Illinois Central R. R. at the extreme southerly end of the proposed reservation. This second camp site is marked (2) on the map Exhibit "E".

The site marked (2) lies between elevations 300 and 400. The country is gently rolling and it is in several respects a desirable camp site. The highway and railway facilities are, however, inferior to those of the lower site for there is only one railway and the highway leading from Louisville through West Point is only a fair one from West Point south, the surface and gradients for a considerable portion of the distance, both being bad. This site was used for an Artillery Camp some years ago and several of the officers at the present camp state that the wells in the vicinity of Stithton were frequently pumped dry. Mr. Shields believes that the questions of a water supply at this site would be a more difficult one than at the lower site. Lt. Colonel Blakely states that site No. 2 and the large area of more broken land which is contiguous to it makes a fine maneuver ground, and both he and Lt. Colonel Corey believe that this site would not bear as desirable a relation to the work to be done on the Artillery Ranges as will a camp on the lower site. Site No. 1 lies south of the L. H. & St. L. R. R., west of the Illinois Central R. R. and south and east of the Abrams Run. The map marked Exhibit "A" shows the area including in the site No. 1 as well as a portion of the adjacent area. A considerable portion of the area surrounded by the steep hills is subject to overflow at times of extreme high water on the Ohio River. Practically all the land between the river and the L. H. & St. L. R. R. is

300
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overflowed at such times, but a considerable portion south of the L. H. & St. L. R. R. is above even the high water of 1913 and a smaller portion above the even greater flood of 1884. A table of the annual high water levels back to 1886 which were the records available at the office of the Weather Bureau in Louisville accompanies this report and is marked Exhibit "F". This report shows that the last two extreme floods have been separated by an interval of 29 years and that during the period of 13 years, for which records are available previous to 1884 that there had been no extreme flood and that during the entire period of more than 50 years, of which records are available, that on average of only once in 5 years did the high water reach a point within 10 feet of the level reached in 1913. Another map which is a profile of the L. H. and St. L. R. R. track from West Point west to a short distance beyond Abrams Run accompanies this report and is marked Exhibit "G". This profile map also has shown on it, in red ink, the extreme high water level of 1913, and it was with the railway track as a base and two lines of levels run south therefrom that there was checked up the appropriate area which lies at elevations above the extreme high water of 1913. There is a ridge running in a general east and west direction from a short distance east of the Louisville and Nashville Pike to a line just east of Abrams Run which lies above this high water level of 1913 and which is as far as could be determined, without a complete survey broad enough for the greater of this length to accommodate the quarters for officers and men of the required two brigades. This land is not great enough in extent to provide the area above high water for all stables, etc., but there is land available for these purposes which would probably not be flooded more frequently than once in 15 or 20 years and even then these stables areas would be inundated only to an inconsiderable depth.

HOSPITAL SITE:

Through Captain Clark, I was informed by the Surgeon General's office that a camp for two brigades of artillery accommodating approximately 10,000 men would require a 500 bed hospital and that there would also be required a veterinary hospital for 500 animals. The 500 bed hospital is afforded a desirable site at the extreme westerly end of the proposed camp and separated therefrom by a space of about 1000 feet. The veterinary hospital for 500 animals would probably best be situated immediately west of the village of West Point about one mile therefrom and near the bank of the river. This would place the veterinary hospital about one mile from the nearest men's quarters in the camp itself. A more exact location for the cantonment itself and for those two hospitals can, of course, only be determined following the completion of a complete topographic survey and the locations shown on the map marked Exhibit "A" are only tentative, but are possible locations.

RAILROAD FACILITIES:

The proposed site No. 1 is bordered on the North by the L. H. and St. L. R. R., on the east by the Illinois Central R. R. and Louisville and Nashville Pike. These two railroads, together, have 14 passenger trains per day which stop at West Point.

HIGHWAYS:

The village of West Point and the camp site lie about 23 to 24 miles from Louisville and from Camp Taylor. The Louisville and Nashville Pike passes through both the village and camp site and is a good road in all respects, being practically level all the way and for the greater part a bituminous macadam construction and the rest of the distance being water bound macadam.

WATER SUPPLY:

Mr. W. S. Shields, of Chicago, is making a report on this subject directly to the Construction Division, attention of Lt. Colonel Maury.

SEWAGE DISPOSAL:

As heretofore stated the proposed camp site lies approximately 4000 feet back from the Ohio River and all sewage disposal can probably be carried by gravity to the river, where, so far as I was able to determine, it can be disposed of without treatment.

ELECTRIC LIGHT AND POWER:

The Louisville Electric and Gas Company at the present has a line to the village of St. Helens, about twelve miles beyond Louisville and about twelve miles from West Point. They estimate that the construction of a new line to the camp site and construction of a sub-station would involve an expenditure of about \$70,000, and state that they would supply electricity at the same rate charged at Camp Taylor, which is 2.1-2 cents per KWH.

ICE AND REFRIGERATION:

At Camp Taylor the ice is purchased from the Louisville Ice Company at 17 1/2 cents per cwt. and they have a refrigeration plant for the storage of meats. I was informed by Captain Porter, Utilities Officer at Camp Taylor, that the Louisville Ice Company could ship to West Point the necessary ice for the purpose of a new camp there and that they would probably deliver same at the same rate plus transportation charges that they charge at Camp Taylor. It would thus appear that an ice making plant would not be necessary, though a refrigeration plant for the storage of perishables would.

LAUNDRY:

I was informed by Captain Porter, Utilities Officer, Camp Taylor, that the Reclamation Division is requesting that a laundry be built at Camp Taylor proper as the present arrangements of sending the laundry into Louisville is proving unsatisfactory. Captain Porter believes that if a new laundry is constructed at Camp Taylor that the laundry from the proposed West Point Camp will be sent to Camp Taylor.

The morning that I arrived at Camp Taylor, I reported to Division Headquarters in company with Major Gilbert, Major Wade and Major Major General Hale, in command, is very enthusiastic over the proposed new cantonment and extension of the artillery range and believes that the present is a most auspicious time for the purchase of the entire area under consideration. The next day I again met General Hale at West Point and he again expressed the wish that I would report his recommendation for the purchase, rather than the lease of this land.

Exhibit B.

REPORT OF SITE FOR SIX BRIGADE CAMP.

(This report should be supplemented by previous report of May 25.)
TO: Engineering Branch Attention Major Gibbs, July 8, 1910.

FROM: Captain F. B. Smith.

SUBJECT: Site for a Cantonment for six Brigades of Artillery, a School for 10,000 men, and auxiliary units, as stated in memorandum of June 25 to the Engineering Branch.

1. Pursuant to orders dated June 27, I proceeded to West Point, Ky., to secure data to assist in estimating the cost of a cantonment for approximately 53,000 men, as outlined in the attached memorandum dated June 29 from

Major Gibbs to the Engineering Branch. For a general description of the location of the West Point Artillery Range and camp site, together with its railway and highway approaches, reference should be made to my report of May 25.

2. At West Point on Monday, July 1, I met Major Gilbert, Constructing Quartermaster at Camp Taylor, and Colonel Blakely, in command of the Firing Center at West Point Artillery Camp. In company with them I visited that section of the proposed artillery range which lies to the north west, north and northeast of the town of Stithton. This area was referred to in my report of May 25th as site No. 2 and is described in said report. In view of the fact that the area described as site No. 1 in my report of May 25 is generally conceded to be altogether insufficient in area for six brigades of artillery, it was agreed in a preliminary way on the afternoon of July 1 that if a six brigade artillery camp was to be built, it should be located on this site, No. 2.

3. I was instructed by General Snow's office through Major Gibbs to consult with Colonel Blakely at West Point, and with Col. Carter at Camp Taylor. Col. Blakely consulted with Cols. Johnson and Corey also situated at West Point. Col. Corey was adverse to building a camp in the vicinity of Stithton and on site No. 2, preferring that the camp should be built on the lowland overlooking site No. 1, or just back from the bluffs on the high land overlooking site No. 1. As heretofore stated, it was generally agreed that site No. 1 was insufficient in area for six brigades, with their various adjuncts, if placed on the high land just back of the bluffs surrounding site No. 1, would be separated by enormous ravines, which would not permit of a reasonably compact and economical layout. Six brigades of artillery in this vicinity would also interfere to a greater extent with the use of the land as an artillery range than would be the case if site No. 2 were used. Colonel Blakely suggested that if possible the extreme northwestern section of the land shown on the plan marked "Exhibit E" accompany the first report, should be used for the camp. The map and available information indicated that this land was extremely rough in character, but at the request of Col. Blakely I made an inspection covering considerable portion of the area, finding it heavily wooded, cut up by enormous deep gulleys with precipitous banks, and traversed by roads which are forbidding in respect to gradients and practically no surface; in fact, almost impossible to traverse even in dry weather except on horseback. There is no single building area in this section, which is above high water mark, large enough to accommodate a single brigade of artillery. The character of this area was reported by me to Colonel Blakely, and he agreed that the only feasible situation for a cantonment of six brigades was evidently on site No. 2, in the vicinity of Stithton. He requested that work should proceed on this basis and that the cantonment should be kept to the south as far as possible, thus interfering to the least possible extent with the use of the remainder of the land as an artillery range.

4. On Tuesday at Stithton I met Mr. Horace Ropes, an assistant to Lieut. Col. Maury, who was sent to make an investigation of the water supply. Mr. Ropes is making a report on this subject to Col. Maury.

5. Railroad Facilities.

The Illinois Central Railroad, which runs from Louisville through Memphis to New Orleans, passes approximately through the middle of site No. 2 and traverses the entire north and south length of the artillery reservation. It would probably be desirable to move this railway to either the extreme edge of the reservation or as near that as might prove feasible. I called on Mr. T. E. Hill, Division Superintendent of

the Illinois Central, who says that some years ago the road considered changing their line, following the L. H. & St. L. Railroad west from West Point to approximately the point where Otter Creek empties into the Ohio River and thence following a draw up to the existing line and joining the same just north of the station of Muldraugh. Col. Blakely agrees that this line would be of practically no benefit to the artillery range. Mr. Hill said that with the maps available it is impossible to determine a new line which might be of some benefit to the artillery range, but he promised that he would send out a prospecting party to determine if there was any other feasible line for the Illinois Central west of the present location of the road. A telegraphic report on this subject was received by the Constructing Division on July 3, which read as follows:

"Referring to request made by Captain Smith on Superintendent Hill at Louisville for investigation, hasty reconnaissance indicates possibilities of diverting Illinois Central line at Vine Grove via Otter Creek Valley to connection with L. H. & St. L. about five miles, lengthening route approximately two miles at a cost of something like one million dollars. This estimate does not include damages incident to abandoning stations on present location. Indications are conditions would be greatly improved by shifting line eastwardly from Vine Grove down Mill Creek to West Point. This company is not materially interested in change of this character, although some advantage might be gained if change could be made on reduced gradients, which can be determined accurately only by survey.

A. S. BALDWIN."

The proposal to divert the railroad at Vine Grove and follow down Otter Creek valley would certainly be of material advantage to the artillery range, as the railroad would thus skirt the range along the extreme western and northern borders. Such a diversion would, however, leave the camp in the vicinity of Stithton several miles off the through railway line. The proposal to divert the line at Vine Grove, following down Mill Creek to West Point, is apparently of less advantage to the artillery range, as it would be necessary in order to fire from that portion of the range on the west side of Mill Creek and Salt River into that portion of the range from the east side of the streams to fire across the railway line. This second proposal would, as in the first case, leave the camp at Stithton several miles from the main railway line. The artillery officers at the West Point Artillery Camp are of the opinion that it would be possible to fire over the Illinois Central Railway line and the Dixie Highway or Louisville & Nashville Pike, proposing that guards with telephonic communication should be stationed at certain points along the railroad and highway to direct the fire of the batteries.

6. Diversion of the Dixie Highway or the Louisville & Nashville Pike.

If it should prove desirable, in view of the expansion involved, to divert the Illinois Central Railway, as in the first proposal of the Railway Company, it would certainly be feasible to divert the Dixie Highway to align approximately parallel with the railroad. The matter of diversion of both the Illinois Central Railroad and the Dixie Highway is, however, one that can be best determined by officers acquainted with the proposed uses of the artillery range.

7. Electric Light and Power.

The village of Stithton at present has a small electric light plant of its own which would be of no value to the proposed camp. The Louisville Electric and Gas Company has a line at the village of St. Helens, about twenty miles distant from the proposed camp site and so far as I was able to determine, it

will be necessary that the camp produce its own electricity.

8. Ice and Refrigeration.

Although I recommended, in my report of May 25, that it would probably be desirable to purchase ice for a small camp to be located near West Point from the Louisville Ice Company at 17½ per cwt., f. o. b. Louisville, it would probably prove necessary to construct both an ice-making plant and a refrigerating plant for a camp of approximately 2,000 men.

9. Sewage Disposal.

As the center of the proposed site lies in the shortest air line about four miles distant from the Ohio River, it would probably be necessary to either construct a long outfall sewer or to construct shorter outfall sewers to Mill Creek at the east of the camp and Otter Creek at the west of the camp. Mill Creek on the 5th of July was flowing at the estimated rate of about 2,000,000 gallons per day. There had been no rain for a week or more, and it is believed that this is approximately the minimum flow of this stream. Otter Creek at the village of Grahampton on July 5 was flowing at an estimated rate of between three and four million gallons per day.

10. Hospital Site.

Through Captain Clark I am informed that the Surgeon General's Office informs the Construction Division that for a camp of approximately 52,000 men, it will be necessary to estimate a hospital of 2,500 beds, so placed that it may be expanded to 3,000 beds. The Construction Division has not as yet received a typical layout of a 2,500 or a 3,000 bed hospital from the Surgeon General's office, but, lacking more detailed information, the hospital site has been selected immediately to the southeast of the village of Stithton on relatively level ground, elevation averaging about 360 feet above low water of the Ohio River, comprising between 200 and 300 acres of good building land practically adjacent to the Illinois Central Railway line. This hospital site lies to the south of the main body of the camp and with the main body of the camp between it and the artillery range proper.

11. Site for 1,000 Animal Veterinary Hospital.

Through Captain Clark, of the Engineering Branch of the Construction Division, I have been informed that Colonel Noble, of the Surgeon General's office states in a preliminary way that we should estimate upon a 1,000 animal veterinary hospital to accompany this proposed camp. The site for such a hospital is evidently available at the extreme westerly end of the proposed camp, in the area between the Bloomington and Grahampton roads, which lies to the northeast of the village of Grahampton. This land is largely open in character and is whole surface drained.

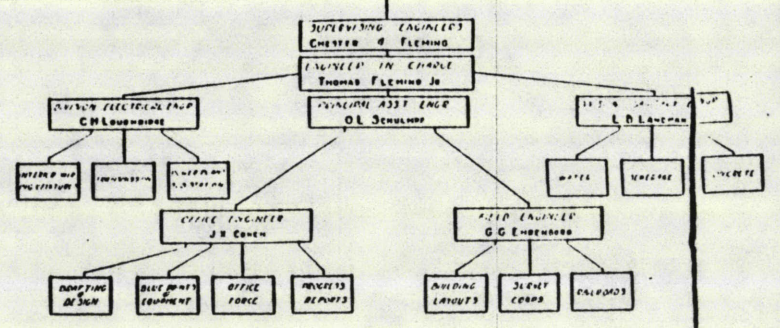
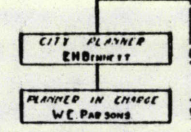
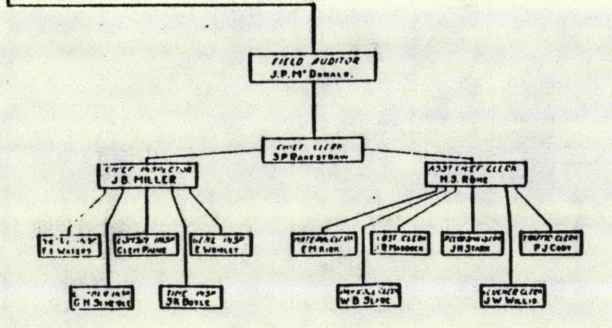
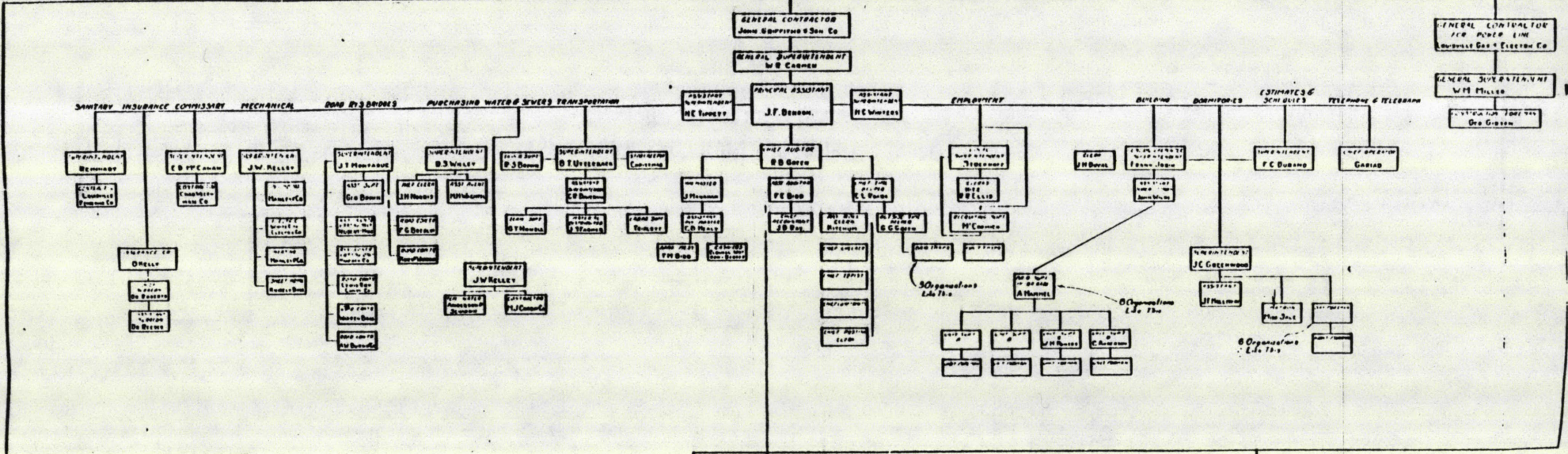
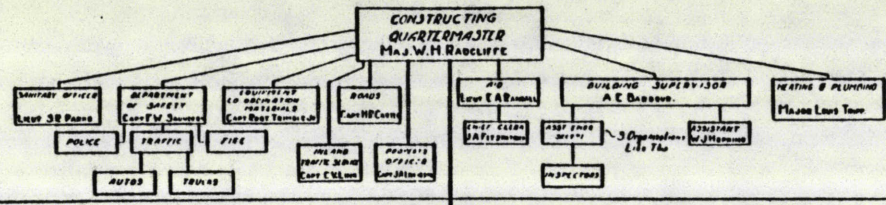
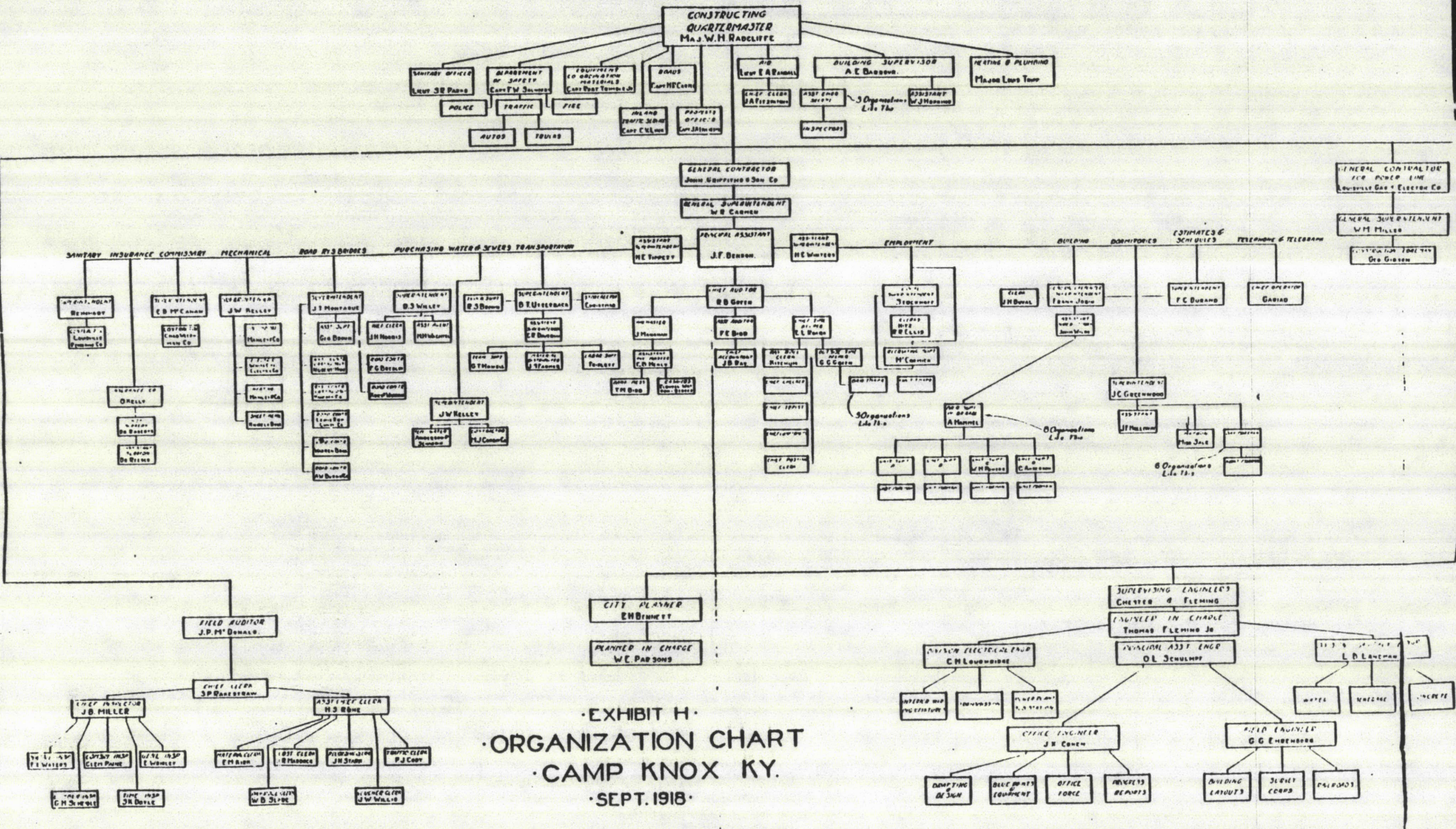
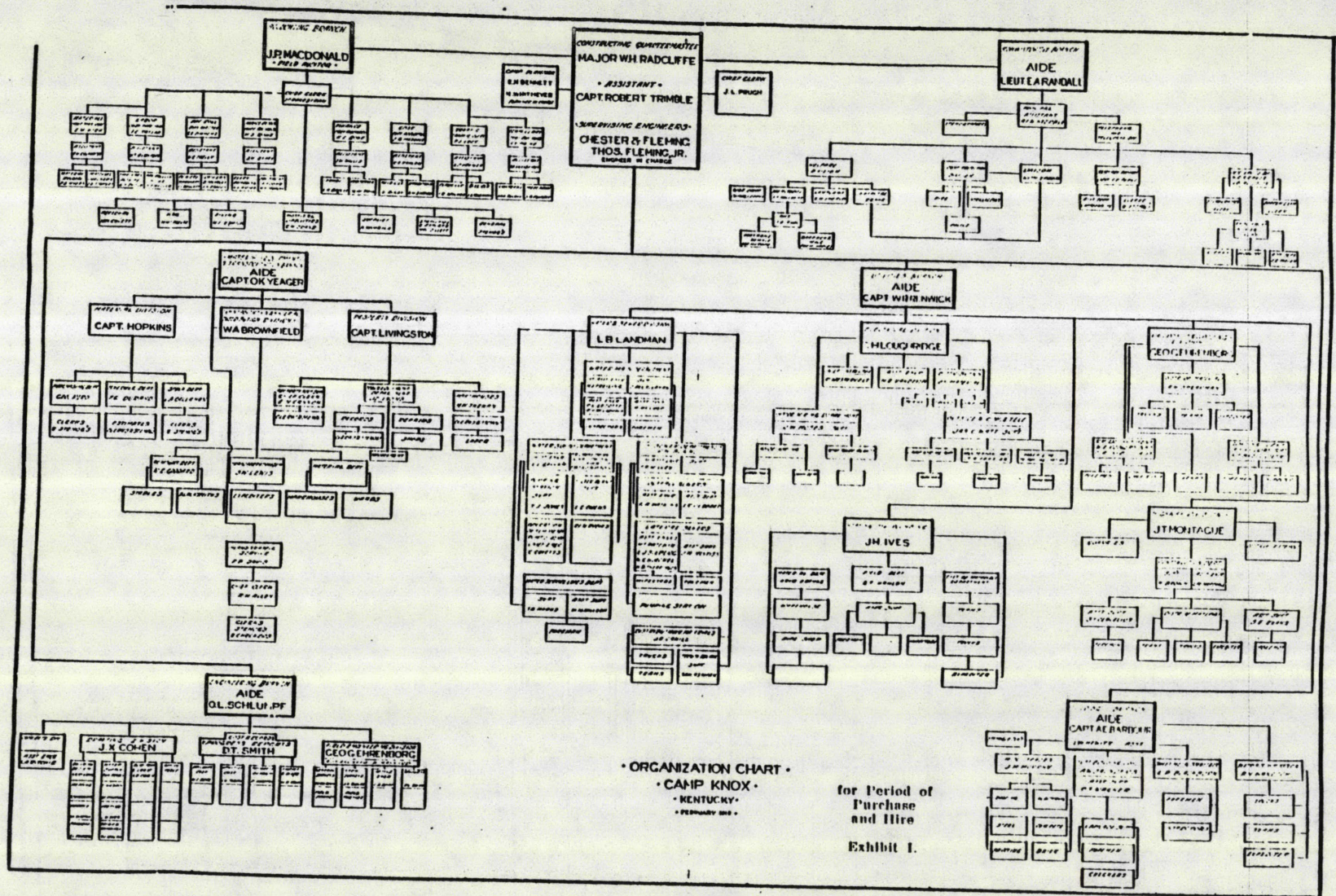
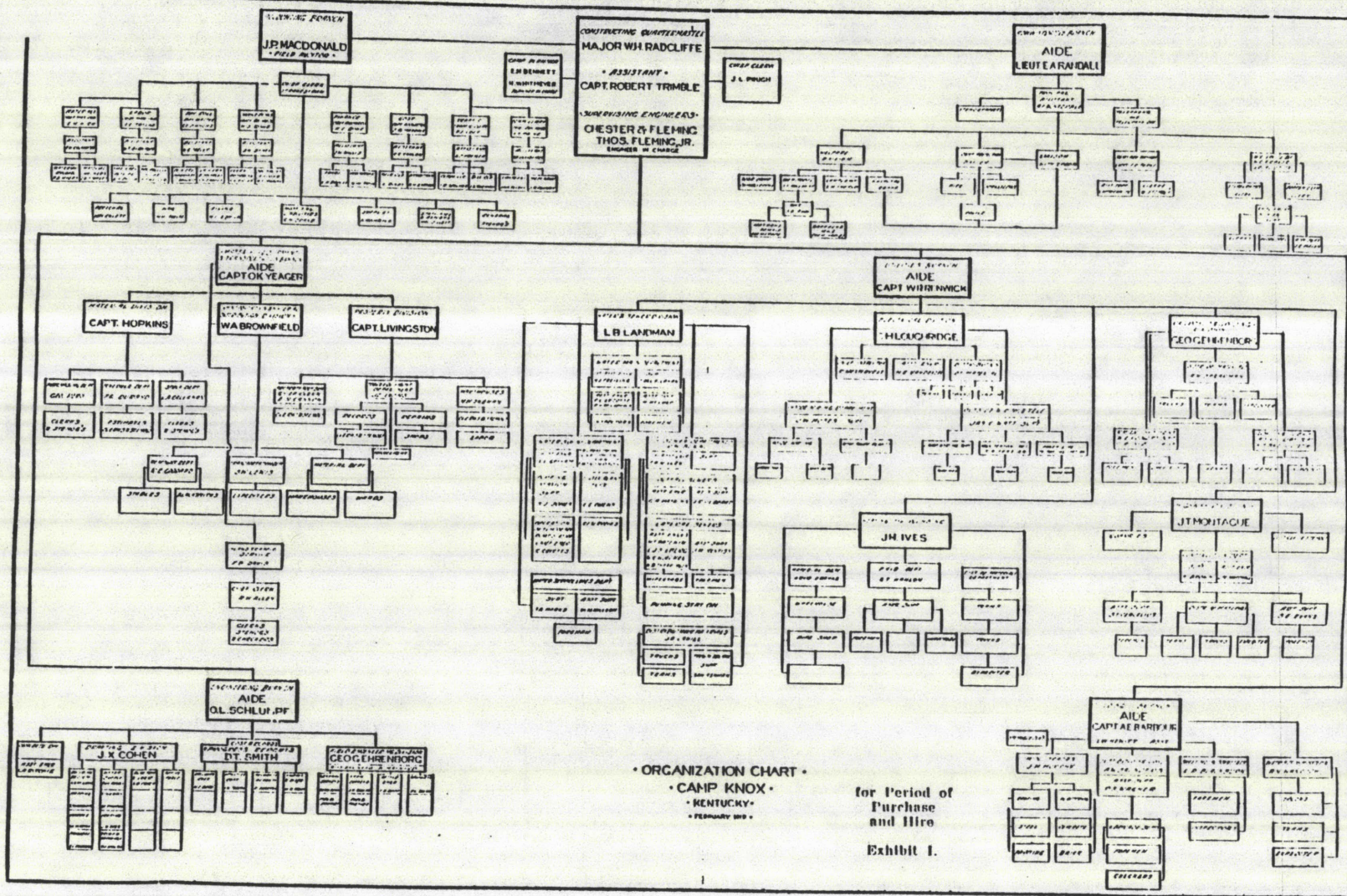


EXHIBIT H
 ORGANIZATION CHART
 CAMP KNOX KY.
 SEPT. 1918





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• ORGANIZATION CHART •
 • CAMP KNOX •
 • KENTUCKY •
 • FEBRUARY 1918 •

for Period of
 Purchase and Hire
 Exhibit I.

This part contains charts of the organization of the camp, including the names and ranks of the personnel, and the names of the various departments and sections.

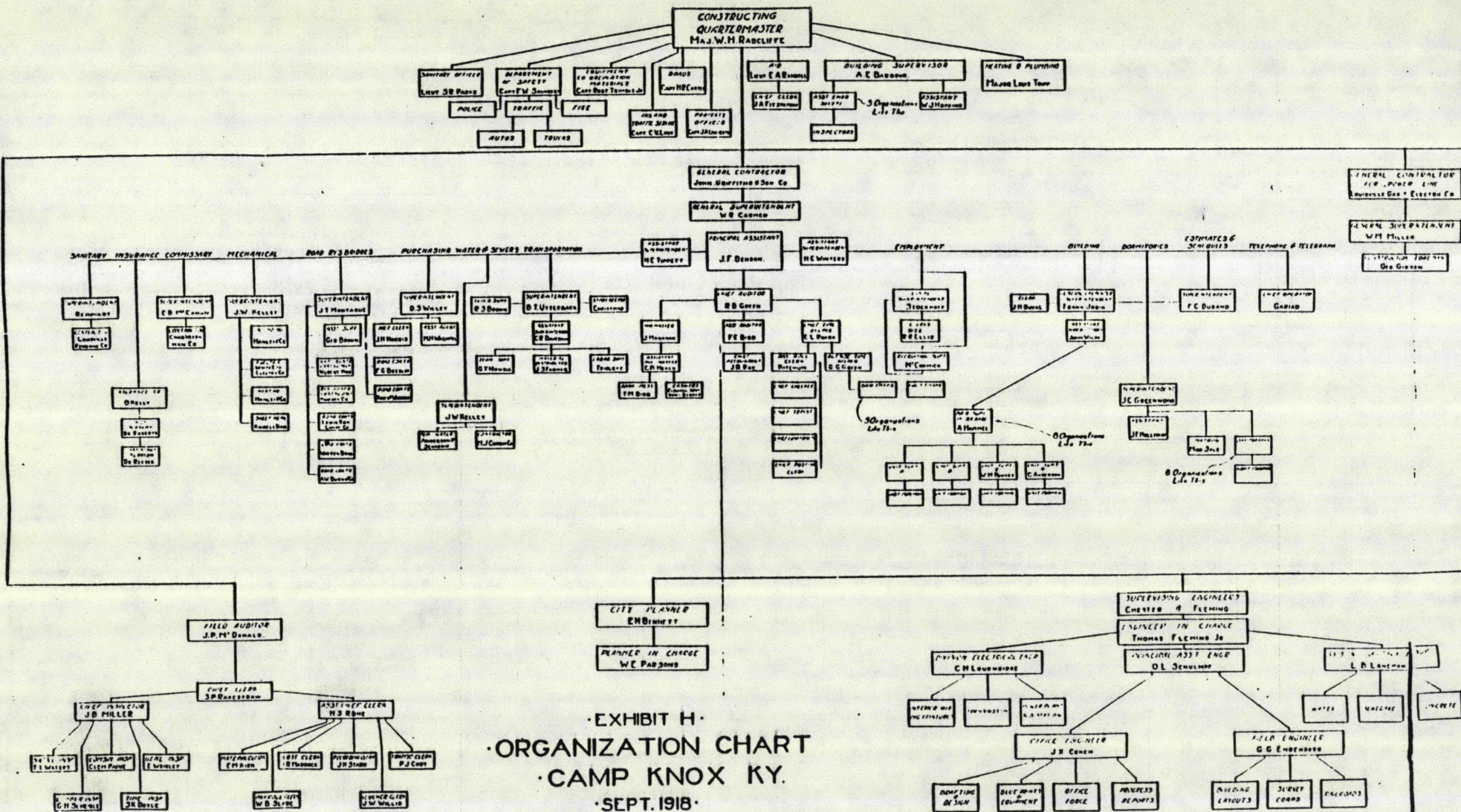
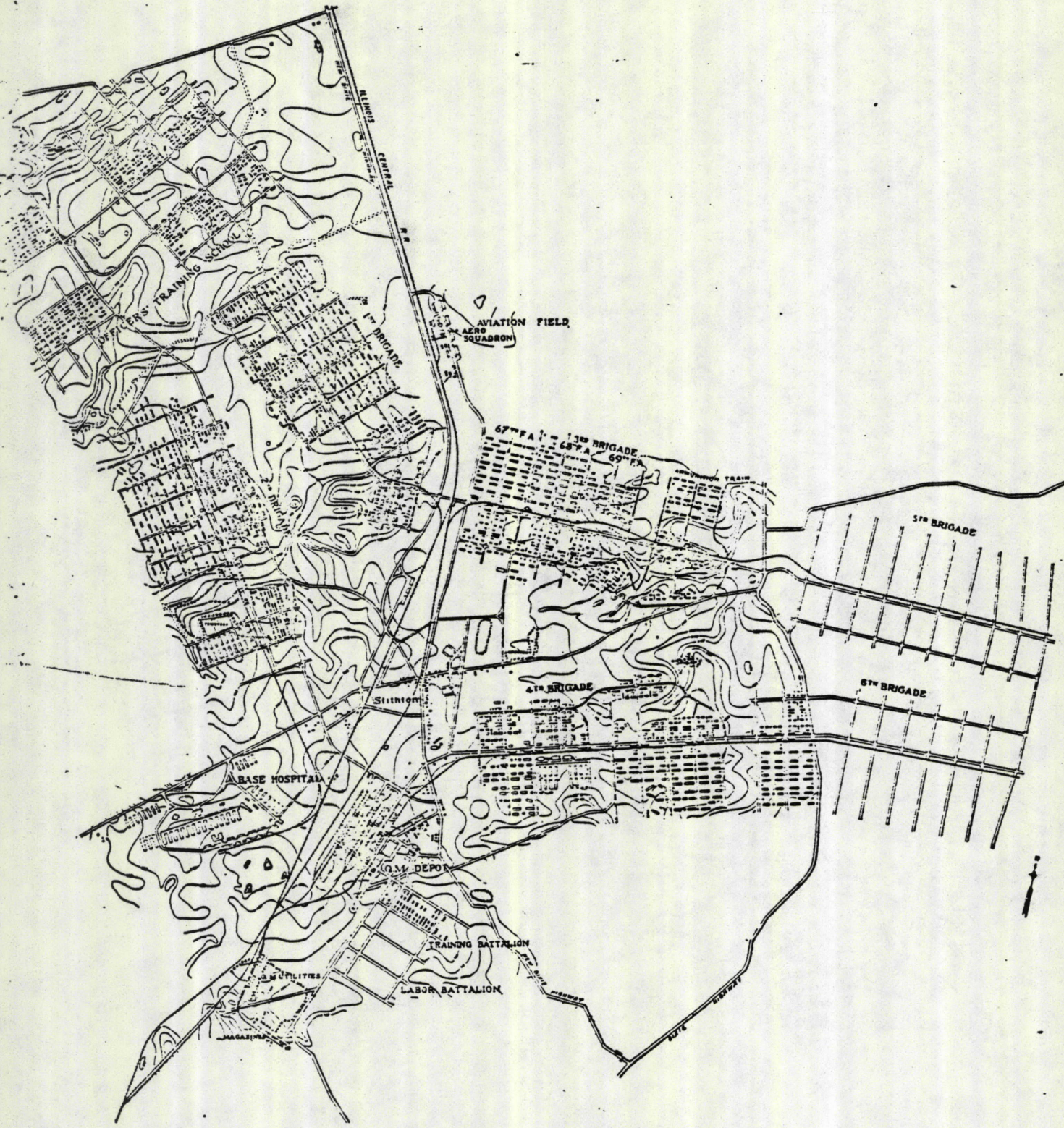


EXHIBIT H
ORGANIZATION CHART
CAMP KNOX KY.
SEPT. 1918

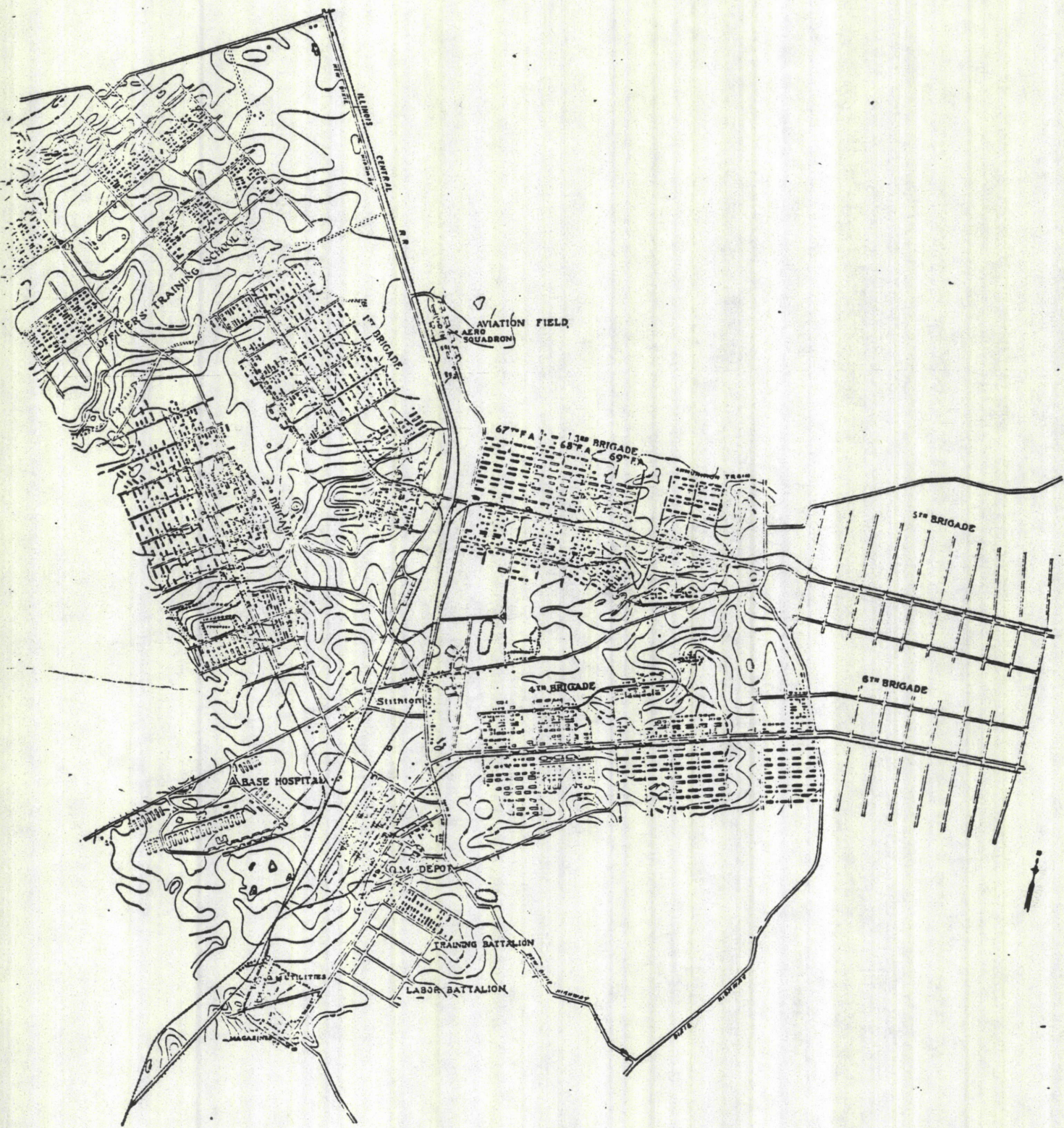
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General Layout
CAMP KNOX
 Kentucky

As Originally Authorized Aug., 1918.
 Scale—one inch equals one-half mile

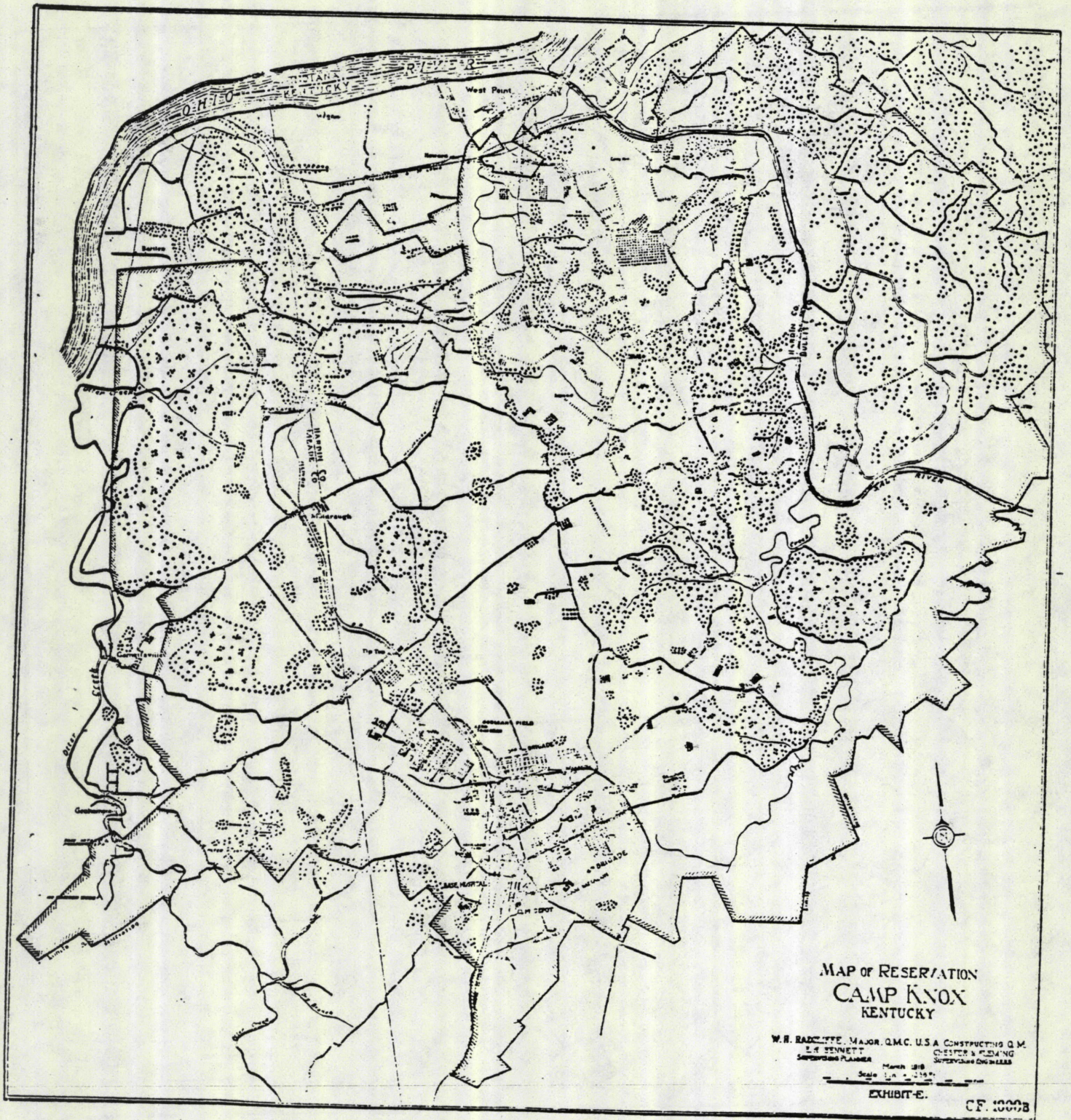
Exhibit C.



General Layout
 CAMP KNOX
 Kentucky

As Originally Authorized Aug., 1918.
 Scale—one inch equals one-half mile

Exhibit C.

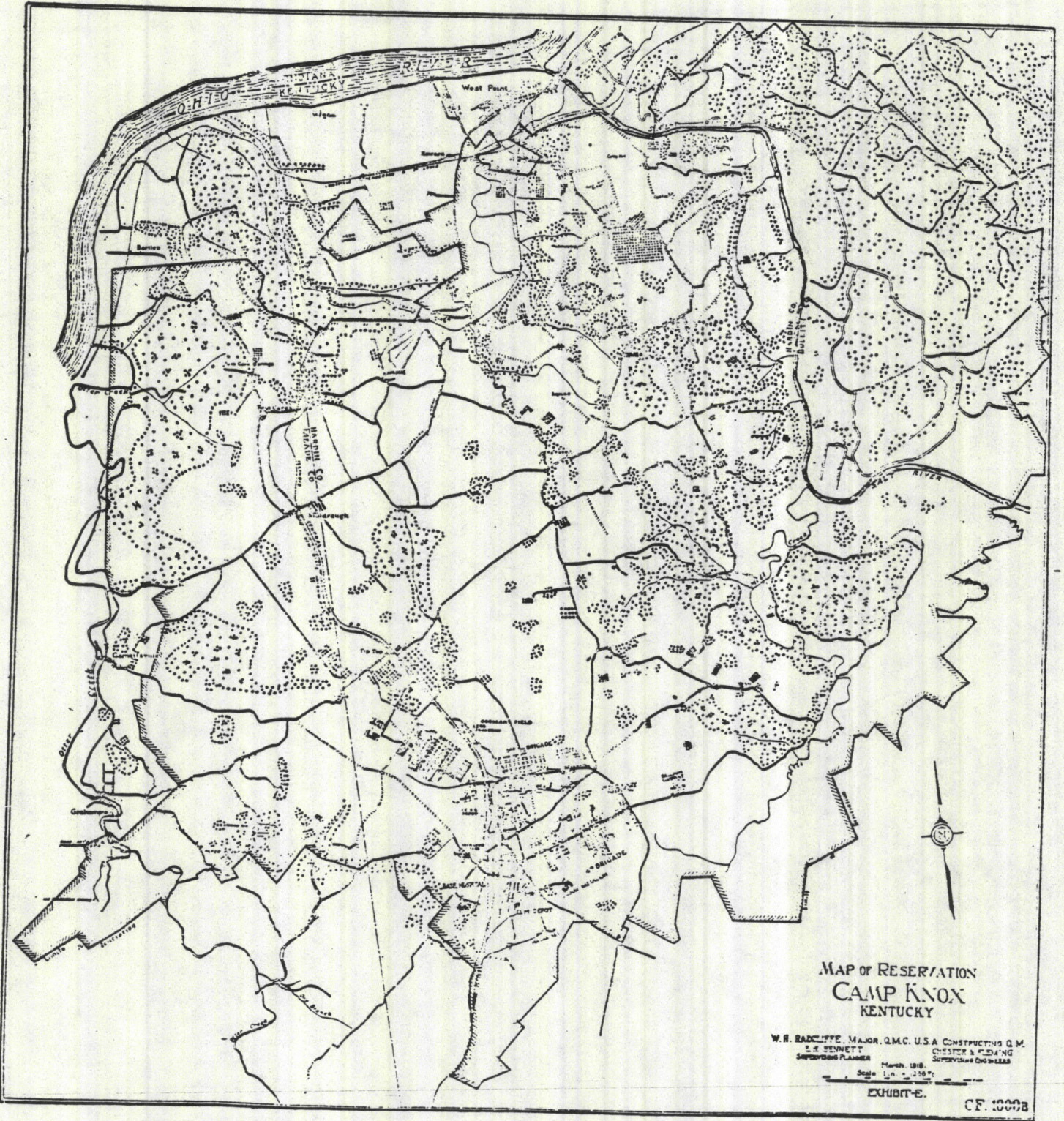


MAP OF RESERVATION
CAMP KNOX
 KENTUCKY

W. H. RACLETTE, MAJOR, Q.M.C. U.S.A. CONSTRUCTING Q.M.
 E. F. BENNETT, CHIEF OF PLANNING
 SUPERVISING PLANNER
 March 1918
 Scale 1 in. = 2 1/2 mi.

EXHIBIT-E.

CF. 10008

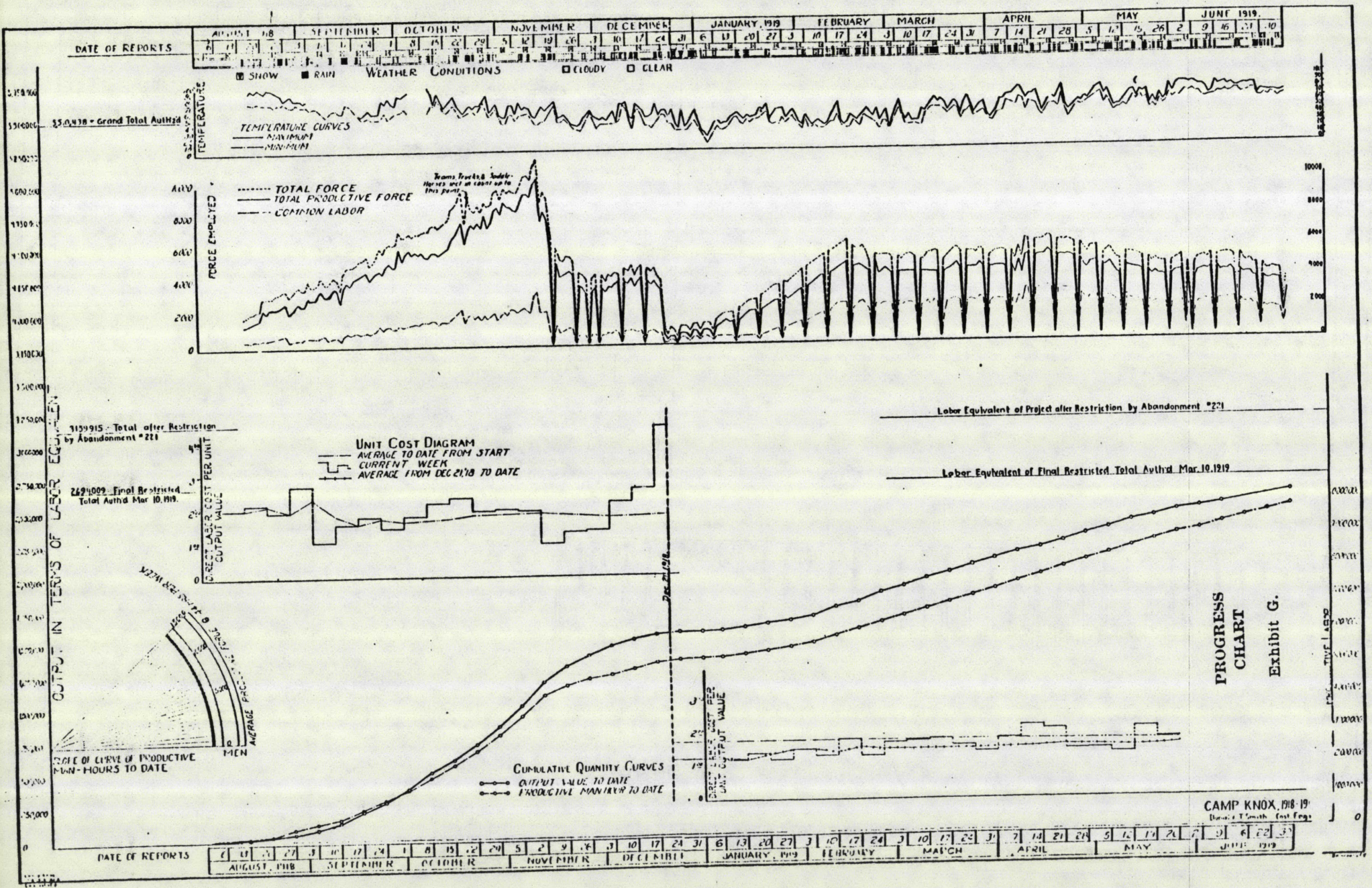


MAP OF RESERVATION
CAMP KNOX
 KENTUCKY

W. B. RADCLIFFE, MAJOR, Q.M.C. U.S.A. CONSTRUCTING Q.M.
 E. E. TENNETT
 SUPERVISOR PLANNING CHESTER & FLEMING
 SUPERVISOR ENGINEERS
 March, 1918.
 Scale 1 in. = 2 1/2 mi.

EXHIBIT-E.

CF. 1000B



35,0478 - Grand Total Auth'd

3159915 - Total after Restriction by Abandonment #221

2624009 - Final Restricted Total Auth'd Mar 10, 1919

Labor Equivalent of Project after Restriction by Abandonment #221

Labor Equivalent of Final Restricted Total Auth'd Mar 10, 1919

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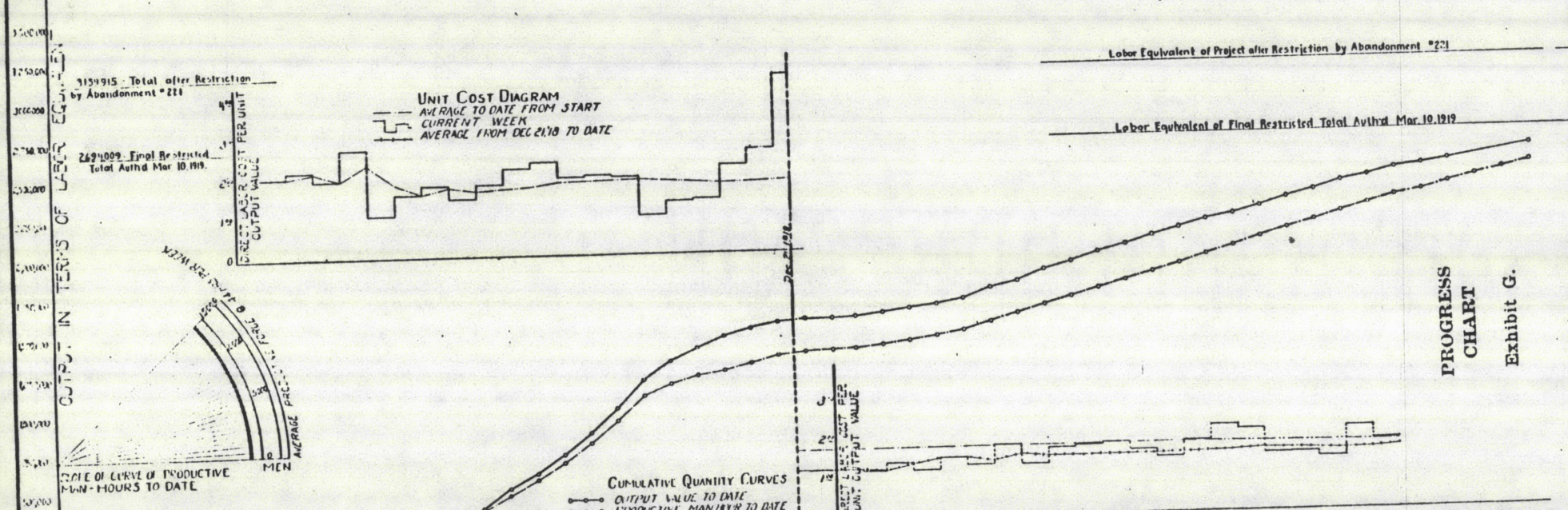
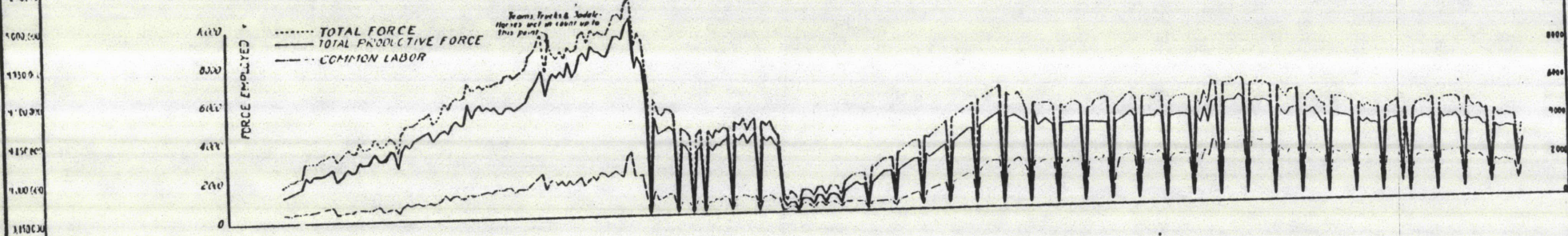
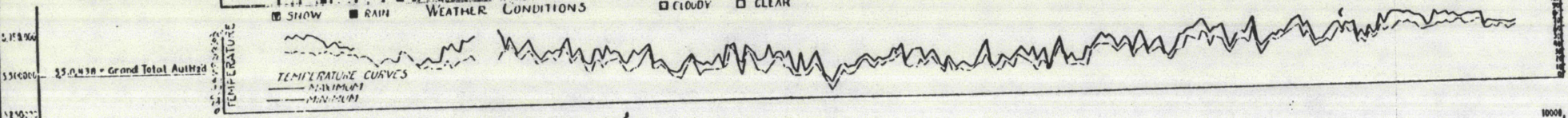
FORCE EMPLOYED

UNIT COST PER UNIT

OUTPUT VALUE

DATE OF REPORTS

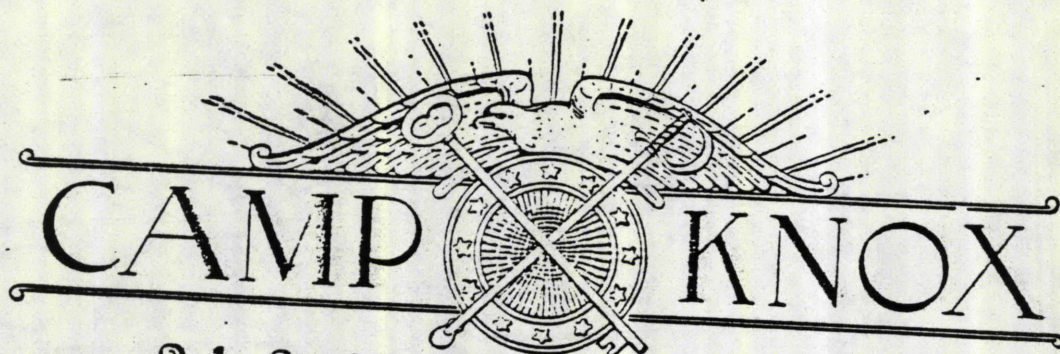
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AUGUST 1918							SEPTEMBER							OCTOBER							NOVEMBER							DECEMBER							JANUARY 1919							FEBRUARY							MARCH							APRIL							MAY							JUNE 1919																						
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PROGRESS CHART
 Exhibit G.

CAMP KNOX 1918-19
 Drawn by Smith East Eng.



CAMP KNOX

Brig. Genl. R.C. Marshall Jr. 2.M.C., U.S.A.
CHIEF CONSTRUCTION DIVISION

Major W.H. Radcliffe 2.M.C., U.S.A.
CONSTRUCTING QUARTERMASTER

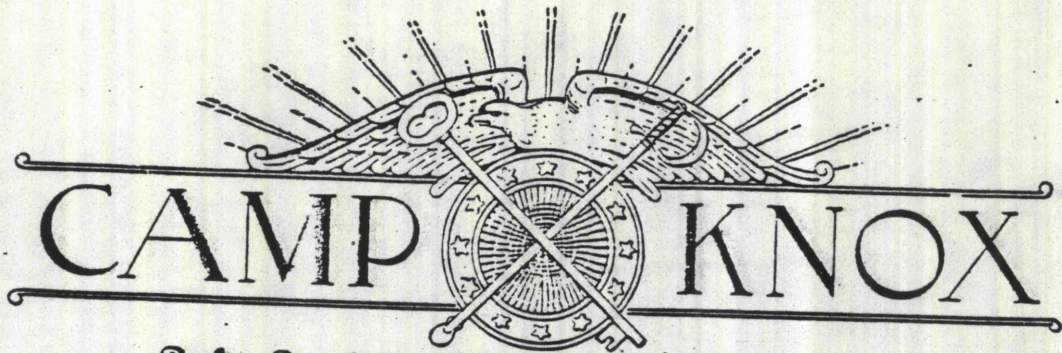
Chester & Fleming
SUPERVISING ENGINEERS

E.H. Bennett
SUPERVISING PLANNER

This certifies that _____
has been employed on the
construction of Camp Knox
for a period of _____ months
and that during that time he
was of material assistance to
the Government of the United
States of America in the pro-
cedure of its construction pro-
gram during the World War....

W.H. Radcliffe
W.H. RADCLIFFE
MAJOR 2.M.C. U.S.A.
CONSTRUCTING QUARTERMASTER

Exhibit J.



CAMP KNOX

Brig. Genl. R. C. Marshall Jr. 2. M. C., U. S. A.
CHIEF CONSTRUCTION DIVISION

Major W. H. Radcliffe 2. M. C., U. S. A.
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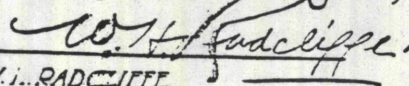

W. H. RADCLIFFE
MAJOR 2. M. C. U. S. A.
CONSTRUCTING QUARTERMASTER

Exhibit J.