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FIELD ARTILLERY GROUP OF THE GENERAL GRANT MEMORIAL UNVEILED IN WASHINGTON, D. C., APRIL 27, 1922.
Henry M. Shrady, Sculptor.

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ANNUAL REPORT OF THE CHIEF OF FIELD ARTILLERY FOR FISCAL YEAR 1922

[EDITOR'S NOTE.—*Due to lack of funds it is impossible, this year, to publish in the form of a public document the annual reports of the several chiefs of the combatant arms. Therefore the following report is published for the information of all those concerned.*]

Contents

Introduction

GENERAL CONDITIONS

In my last annual report I had occasion to state that the efficiency of the Field Artillery organizations of the Regular Army was extremely low, and I further cited the reasons therefor. I am gratified to be able to state now that, in spite of the many handicaps to training still existing, there has been a marked improvement in the efficiency of all these organizations during the present fiscal year. Since January, 1922, all the Field Artillery units of the Regular Army in this country have been thoroughly inspected by a representative from this office, and the reports indicated that at the time of the inspection morale was high, that training was taking place along sound lines, that officers were interested and working hard, and that a rapid advance towards real efficiency throughout the arm was taking place. Since that time Congress has passed legislation requiring a reduction in the strength of the commissioned personnel through elimination and demotion, and a reduction in the strength of the enlisted personnel, which, in my opinion, is having a demoralizing effect on the service generally.

SCHOOLS

The principal factor in this improvement is the work of those officers who have graduated from the Field Artillery Schools. These graduates are beginning to leaven the large number of poorly or partially trained officers, who entered the Army during and subsequent to the World War. These officers are almost uniformly energetic and enthusiastic, but circumstances have not afforded them a thorough grounding in the technic of their arm. Upon these officers, the graduates of the Special Service Schools have exerted a great influence, and this influence extends still further to the training of the enlisted men.

Rapid developments of recent years make demands upon the officer of Field Artillery which were unheard of before the war. He is required to be proficient in a wider range of technic and in the use of a greater variety of matériel than ever before. Under these conditions, I consider it to be axiomatic that thorough and uniform standards of education cannot be attained without a suitable system of Special Service Schools. The work of our Field Artillery Schools up to date having so thoroughly proven its excellence and its adaptability to existing conditions, I profoundly regret that the system is now being changed upon the recommendations of the recently

appointed general board. The changes so recommended were doubtless believed to be in the interests of economy. In my opinion, the amount of such economy, if there be any at all, will not be commensurate with the resulting loss in efficiency.

RESERVE CORPS

Some improvement has taken place during the past year in the status of the Field Artillery Reserve Corps. Upon the signing of the Armistice, November 11, 1918, there were some 23,000 officers of Field Artillery in our Army. There should be not less than 20,000 Field Artillery Reserve Officers available to properly prepare for a national emergency. There are at present about one-third of this number commissioned. This number should be augmented as fast as practicable from every available source. The formulation of a definite War Department policy and corresponding regulations for the Reserve Corps, which were completed during the past year, and the assignment of Reserve Officers to definite organizations and duties will doubtless result in an increase of interest and efficiency on the part of Reserve Officers; but no real life can be breathed into the Reserve Corps without the necessary funds. Unless Congress makes more liberal provision for the transportation and training of Reserve Officers, the whole scheme is bound to remain largely a paper organization. These officers are in the main enthusiastic and willing and are a tremendous asset to the nation. To maintain their interest and insure their coöperation will require a very reasonable expenditure of funds, the returns from which will be beyond all proportion to its amount. The government cannot afford to allow present conditions to continue.

RESERVE OFFICERS' TRAINING CORPS

The Reserve Officer Training Corps Units of Field Artillery continue to make satisfactory progress. These units, located at twenty of the largest colleges and universities in the country, have as an object the training of Second Lieutenants for the Reserve Corps. They are the main source of Reserve Officers. There are now about 6100 students under instruction, which is a satisfactory number. Courses are being standardized, the attitude of the faculty is generally satisfactory, and the interest of the students is all that can be desired. A cost system, kept in this office during the year, has resulted in saving money wherever practicable, and I know of no part of the military establishment where greater results are obtained for the funds expended. The success of these units depends to a great degree upon the personality and the policy of the officers detailed therewith, and with practically no exception the officers detailed as professors or instructors have done admirable work.

NATIONAL GUARD

The Field Artillery of the National Guard continues its healthy growth. There appears to be some disposition on the part of the Guard to limit its organization to Divisional Artillery. Failure to organize Corps and Reserve Artillery units in the National Guard will result in a one-sided and unbalanced military force, which would be a serious mistake. Our present division is very much smaller and less powerful than the division used in the World War. It is totally devoid of howitzers and therefore is incapable of counter-battery work against the enemies' guns or any other operation requiring larger calibres than 75 mm. Under such conditions, the frequent reinforcement of Divisional Artillery by Corps and G.H.Q. reserve, medium and heavy calibres, will be imperative, and consequently, the maintenance of a proper proportion of these latter units in the Guard is essential.

DEVELOPMENT OF GUNS AND CARRIAGES

Experimental development of new guns and carriages has gone forward satisfactorily during the year. This country has on hand as a result of the World War a reasonable supply of guns of all calibres, and it is not contemplated replacing or adding to this stock. Nevertheless, since the development of a new gun is the work of years, and since advances in metallurgy, chemistry and mechanics in the industrial world enable us to build better guns and ammunition, the Ordnance Department of the Army must carry on continuous experiments with a view to developing improved guns and ammunition to the point where they can be put into production immediately upon the outbreak of hostilities. I strongly urge liberal appropriations for this experimental work, which cannot be executed after the outbreak of war.

MOTORIZATION

I regret to report that the very important experiment of substituting motor traction for horses in the Divisional Artillery, which has been under way since the spring of 1919, has had to be practically abandoned during the present year. In the reduction of the Army to meet legislative restrictions, all the motorized divisional regiments in this country were perforce eliminated from the active list, and funds have not been available to transfer the motorized equipment from these regiments to one of the remaining organizations. At the present moment, the only motorized light organizations are the First Field Artillery, Fort Sill, Oklahoma, which is, however, only partially motorized, and one battalion of the 83rd, at Fort Benning, Georgia. Both of these are school units. As soon

as conditions in the Army are sufficiently stabilized and funds available, it is my intention to resume this experiment and push it to a conclusion. The problem of motorizing Divisional Artillery is far from being solved, and will require a great amount of time and energy before a satisfactory conclusion is reached.

In general, it may be stated that three years' work has resulted in securing a large mass of engineering data on tractors (the development of which is far behind that of trucks and automobiles), a considerable amount of experience in the care and operation of tractors under field conditions, where repair and upkeep facilities are very limited and a great deal of information concerning the character and amount of training required by both officers and enlisted men.

TRAINING (ORGANIZATIONS)

The character of the training throughout the Field Artillery organizations during the present year has shown a marked improvement over that of last year. The principal factors militating against even greater progress has been in the main, excessive fatigue duty, shortage of officers and men, continual changes in strength and station, and the universal uncertainty as to personal prospects for the future among both officers and noncommissioned officers. These factors have produced great unrest and uncertainty throughout the Field Artillery as well as throughout the rest of the Army, and training will not be satisfactory until conditions in the Army have become more stabilized.

REDISTRIBUTION OF FIELD ARTILLERY

Recommendations redistributing the Field Artillery in the United States to stations has been approved recently. This redistribution, I have not the slightest hesitancy in saying, will result in increased efficiency of the arm. The new allocation gives at least a battalion to each Corps Area, results in the Field Artillery being at more comfortable stations for both men and officers and, with one or two exceptions, will add to their training facilities. In addition, the new locations will enable the National Guard and Organized Reserves to receive more aid from the Regular Army than was possible formerly.

PERSONNEL

The Appropriation Bill for the present fiscal year 1922–1923, approved on June 30, 1922, renders inevitable a very unsatisfactory condition of affairs for the first half of the next fiscal year. Its sweeping provisions in regard to personnel of the service are creating marked unrest on the part of many officers and noncommissioned officers. The prospect of elimination or of demotion, and the many

changes in assignment which will result from the separation of a large number of officers from the service is certain to prolong the present condition of unrest and instability in the Army. In my opinion, the system of elimination provided by the Act of Congress approved June 4, 1920, was one of the wisest provisions of that wise and carefully considered law. Under its provisions, this office has completed a careful classification of all Field Artillery officers, and I am satisfied that practically all of the unfit or unsuitable have been separated from the service, with due regard to justice both to the individual and to the government. Under these circumstances, it is most unfortunate that further eliminations are about to take place under the provisions of recent legislation. Under any plan which is adopted, the Army and the Field Artillery are bound to lose officers whose ability and services are satisfactory and who now represent a considerable investment by the government. It will be impossible to replace most of them, since all of them have had the benefit of war experience, and the majority of them have had the benefit of pre-war training.

I consider it necessary that in the reduction of commissioned personnel which is to take place that some means be found for more equitably dividing among the different arms those officers remaining in the service. Since the period of demobilization, the Field Artillery has never possessed its full quota of officers. On the contrary, the total number commissioned in the arm has been only about sixty per cent, of the authorized number. This condition has not only imposed a severe handicap upon the training of its own organizations, but has also resulted in the Field Artillery being unable to furnish its proper proportion of officers for duty with such activities as the National Guard, Organized Reserves, Recruiting, etc., etc. This matter I mentioned in my last annual report, and earnest efforts have been made to secure transfers from other arms to the Field Artillery.

I desire to lay special emphasis upon this subject. The efficiency of the entire Field Artillery of the country, Regular, National Guard and Reserve, depends directly upon the Regular Officers of Field Artillery, and without a full and thoroughly trained quota, I see no prospect of bringing the National Guard and Reserve Units up to even a reasonable standard of proficiency. The recently enacted Appropriation Bill directs a reduction in each arm to seventy per cent, of the number of officers authorized for it in the Act of June 4, 1920. The Field Artillery has never had seventy per cent, of its authorized strength since demobilization, has not seventy per cent, of its authorized strength now, and if reliance is placed upon the ordinary sources of supply, will not have seventy per cent, of its authorized strength for some years to come. Any elimination of Field Artillery officers which may take place will render this shortage still more acute. It is idle to believe that the immense field confronting

this arm can be covered by the present inadequate personnel. With all the emphasis at my command, therefore, I desire to urge that every legitimate means be employed to increase the number of officers to the maximum at present authorized.

OFFICER TRAINING

I have referred above to the excellence of the work done by the Special Field Artillery Schools. Up to the present there have been three in operation. Two of these—the Basic and the Battery Commanders'—have been in eminently successful operation since 1919, and the third—the Field Officers'—has just completed its first course at Camp Bragg, North Carolina. The instruction at the latter school was excellent, and I considered it a marked success. During the year there were graduated from the Field Officers' Course, seventeen officers; from the Battery Commanders' Course, seventy-nine officers; and from the Basic Course, one hundred and thirty-six officers. The curricula of these schools were so arranged that an officer upon the completion of the three courses would have received a thorough training in all the duties which might devolve upon him in any grade from Second Lieutenant to Brigade Commander, and my conclusion is that this object was fully attained.

In addition to the training of the officers, the Enlisted Specialists' Courses graduated a total of three hundred and forty-one enlisted men, with a high degree of training in the specialties of the arm. Nineteen officers of the National Guard and fourteen officers of the Organized Reserves, attended the Field Artillery School during the year, and successfully completed special courses, especially drawn up for them. In addition, four brigadier generals of the Regular Army, whose prior service has been in other arms, were given a special three months' course, to fit them for the command of Field Artillery Brigades.

Seven Regular Field Artillery officers completed technical courses at civilian universities, under the provision of law which authorized two per cent, of the total number of officers to be detailed on this work. Owing to the shortage of Field Artillery officers for duty, no fuller advantage could be taken of this provision.

WAR PLANS

The War Plans section of the office of the Chief of Field Artillery has continued its work during the year, keeping all Field Artillery plans up to date. This section did not exist prior to the World War and consequently there was a loss of months of valuable time at the outbreak of the war. It was not until the establishment of the office of the Chief of Field Artillery in February, 1918, that practical and working war plans for this arm were devised. This delay will be saved in the next emergency. The work being confidential, cannot be described at length in this report.

THE FIELD ARTILLERY BOARD AND DRILL REGULATIONS BOARD

The Field Artillery Board has performed satisfactory work during the year, having tested a great number of devices and conducted a large amount of investigation and research work. As this board had a large amount of work confronting it, I found it advisable to convene a special board for the important duty of rewriting the Drill Regulations for the arm. This latter board has made more satisfactory progress than could reasonably have been anticipated, in view of the scope and importance of its work. Field Artillery literature, technic and doctrine became greatly diversified during the World War, owing to the use of foreign matériel, contact with foreign ideas and practice, and in some cases the adoption, as a matter of expediency, of foreign manuals in their entirety. It is of the utmost importance that our Field Artillery doctrine and practice, which were perfectly sound prior to the war, should be brought up to date and made uniform for the entire service, while at the same time certain fallacies and inconsistencies should be eliminated. In view of the rapid and satisfactory progress which has been made, I anticipate the completion of all the new regulations for the arm during the coming fiscal year.

More detailed information covering the above subjects is contained in the body of this report.

Subjects

I. SPECIAL SERVICE SCHOOLS (OFFICERS)

Three courses for Regular Field Artillery officers were conducted in the Field Artillery Special Service School; the Basic Course at Camp Knox, Kentucky, the Battery Officers' Course at Fort Sill, Oklahoma, and the Field Officers' Course at Camp Bragg, North Carolina. Instruction in these courses was received by a total

of two hundred and thirty-three (233) officers. In addition, special courses were given for four (4) general officers; thirty-two (32) Observers, Air Service; nineteen (19) National Guard officers, and fourteen (14) Reserve Officers. If sufficient funds are available for mileage and transportation, an approximately equal number will be detailed as students next year. This will still leave about one hundred and fifty (150) officers appointed from an emergency status who need courses at the Field Artillery School.

All courses were extremely satisfactory and the results have been most gratifying. The value of the basic course has been especially noticeable in the work of graduates of previous classes on duty with organizations and as instructors in the R.O.T.C. The necessity of using Regular Field Artillery officers very early in their service as instructors with the National Guard and Organized Reserves and in R.O.T.C. Units and in Civilian Military Training Camps make it imperative that they complete the first course at the Field Artillery School during their first two years of service.

In view of the small number of officers newly commissioned this year (about 25), it will be practicable to have all of them report at one place—the Second Division—for their first year's study. After that, they should attend the first-year course at the Field Artillery School at Fort Sill. In my opinion, no Field Artillery officer has a sound technical foundation upon which to build until he has completed this course.

The Battery Commanders' or Technical Course, at Fort Sill, Oklahoma, which is the one next above the Basic Course, has functioned satisfactorily during the year. Due to the lack of homogeneity in the Field Artillery knowledge possessed at present by the officers of this arm, and to the large number of officers needing instruction, it has not yet been practicable to send any of the Basic Course graduates to the Technical Course. It is hoped to do so in 1923.

The Field Officers' Course, which is the highest in the Field Artillery School, held its first course this year. Although the course did not reach perfection, it was, on the whole, very gratifying, and much valuable information was secured to be incorporated in the next class schedule.

Under a recent decision of the War Department and in the interests of economy, all Field Artillery Schools are now being combined at Fort Sill, Oklahoma, and the three courses formerly held at three separate places, will be combined into two.

II. SPECIAL SERVICE SCHOOLS (ENLISTED SPECIALISTS)

Courses were conducted at the Field Artillery School, Fort Sill, Oklahoma, for horseshoers, stable sergeants, battery mechanics,

motor mechanics, master sergeants, communications specialists, and clerks. A total of three hundred and forty-one (341) enlisted men were enrolled in the above courses. Only one regular course for each class of specialists was held during the year due to lack of transportation funds. For the same reason, students could not be returned to their organizations after the completion of the courses and were held at Fort Sill for periods varying from three weeks to four months until funds were made available. During this period, further instruction was given to these graduates, but organizations were deprived of their services for a considerable period.

III. COMMISSIONED PERSONNEL, FIELD ARTILLERY RESERVE CORPS

The publication of the regulations governing the Organized Reserves, assignments of Reserve Officers to units allotted to the different Corps Areas, and the assignment of regular officers to duty with reserve units, are the three factors which have contributed most to maintaining the interest of the Reserve Officers and to renewing the interest of those former officers who failed to accept commissions in the Reserve Corps. There are now a total of 7401 Reserve Officers who have accepted commissions in the Field Artillery section. Of this number, 848 were commissioned during the fiscal year 1922. The losses for the year amount to 586. Of these, 261 were dropped from the rolls, principally for the reason that they could not be located by the Adjutant General; 133 resigned; 106 transferred to other arms; 71 were discharged for various causes, and 15 died. A large majority of the officers who were lost held commissions in the two lieutenant grades.

Special Regulations No. 43, War Department, 1921, definitely defines the policy of the War Department with regard to all activities of the Reserve Officer personnel. Before these regulations were published there was no definite policy laid down as to the qualifications of an officer for appointment, nor for promotion. Immediately after the World War a great many officers were appointed to the Reserve Corps, in many cases in a higher grade than that which they held during the war. This action by the War Department naturally created the impression among a great many of the former officers that they would be commissioned in higher grades if they were to come back into the Reserve Corps. As long as there was no definite policy it was very hard to prevail upon officers to accept commissions in the grades they formerly held even though they were not professionally qualified to be commissioned in higher grades. This difficulty has been removed by a definite statement as to the qualifications required for appointment and for promotion, and now many officers are accepting commissions.

Assignment of Reserve Officers to units of the Organized Reserve has gone forward very satisfactorily. In the divisional troops, every one of the fifty-four horse-drawn 75-mm. regiments has assigned to it a number of officers. Of the twenty-seven brigade headquarters, the initial organization of twenty-one has been accomplished; and of the twenty-seven division ammunition trains, twenty-two are now being organized. There are eighty-four units designated as corps troops; fifty-one of these have officers assigned. Of sixteen units designated as army troops, nine have officers assigned. There are sixty-five units allotted to the General Headquarters troops; only twenty-four of these organizations have had officers assigned to them, due to the fact that they are to be the last units organized. Some difficulties have been met with regard to assigning officers to organizations, as many of the officers held commissions during the war and quite naturally wish to be assigned to their old organizations. This was impossible, due to the fact that many of the organizations have been allotted to Corps Areas different from that in which the officer resides.

The technical classification of all Reserve Officers has been completed and their records are now on file in this office. From these records it is now possible to select special officers for special missions that arise in an emergency. The War Department has furnished the serial number and data covering the active service in the present grade or higher grade of each Reserve Officer and this information has been made a part of his record. The distribution by group of the 7401 officers is as follows:

General Assignment Group for duty under the direction of the War Department General Staff, 8; Branch Assignment Group, under the direction of the Chief of Field Artillery, 660; Territorial Assignment Group for assignment to units by the Corps Area Commanders, 6733. During the past year the allowance for the Branch Assignment Group was reduced by the War Department from 1904 to 663, thereby releasing 1241 officers for assignment to units of the Organized Reserve. The distribution of the 663 officers in the Branch Assignment Group is as follows: Four are for duty in the office of the Chief of Field Artillery; 280 to the Basic Field Artillery School, and the remainder, 379, for duty in the Battery Officers' School. Of the 11,937 officers needed for the Field Artillery units allotted to the Reserve Corps, there are now available 6841, or fifty-eight per cent.; but with the increase in the number of officers commissioned each year by the Reserve Officers' Training Camp, and with the former officers returning to the service, it is hoped that this shortage will be materially reduced in the near future.

The War Department plans call for the assignment of 150 Field Artillery officers of the regular establishment for duty with the Field Artillery organizations allotted to the Organized Reserve. As there are now but twenty-two regular officers assigned to this duty, it has been impossible for them to confine their activities to Field Artillery units. Some of them have been used in the capacity of divisional staff officers. This condition is being corrected as fast as regular officers become available for assignment, and it is hoped that in the near future the full complement of Regular Field Artillery officers will be on duty with the Organized Reserves. It is noticeable

DISTRIBUTION OF REGULAR OFFICERS AND RESERVE OFFICERS OF THE TERRITORIAL GROUP.

	Regular Officer		Colonels		Lt. Colonels		Majors		Captains		1st Lieut's.		2nd Lieut's.		Total	
Corps Areas	Field Officers ssigned	Field Officers Authorized	Assigned	Unassigned	Assigned	Unassigned	Assigned	Unassigned	Assigned	Unassigned	Assigned	Unassigned	Assigned	Unassigned	Assigned	Unassigned
1st	12	4	3	2	2		13	11	18	24	45	44	144	207	225	288
2nd	27	3	3	2	11	3	37	14	99	32	152	18	548	66	850	135
3rd	20	2			5	2	15	8	26	25	111	21	164	306	321	362
4th	11	2	4		4		30	3	50	15	118	14	385	59	591	91
5th	20	1	3	2	1	2	13	7	59	13	93	26	401	181	570	231
6th	22	3	3	2	4	3	22	5	48	21	73	45	373	210	523	286
7th	15	2	4	1	6	2	23	13	46	30	85	34	229	382	393	462
8th	12	2		2	1		15	9	49	33	59	56	143	250	267	350
9th	11	3	2	6	5	2	16	11	55	29	82	56	169	306	329	410
Overseas Dep't.										3		9		15		27
Unass'd.																22
Totals	150	22	22	17	39	14	184	81	450	225	818	323	2556	1982	4069	2664

to a marked degree that where the regular Field Artillery officers are on duty with Field Artillery units, former officers have been induced to accept commissions and assignments in Field Artillery units, and the organization of the units has progressed rapidly.

On account of the shortage of funds allotted for training purposes for the past year only a limited number of officers could be ordered to active duty, and these were sent for a special course at the Field Artillery School, Fort Sill, Oklahoma. Each of the nine Corps Areas was authorized to send two officers to this school. The course started the first of March and was completed the twentieth of May. As this course was given in the spring and not during the training season, some of the Corps Areas were unable to get officers to attend. Of the eighteen authorized, fourteen took the course. The Commandant of the Field Artillery School stated upon completion of the course that the fourteen students had been very enthusiastic and had done exceptionally well. The training for the Field Artillery Reserve Officers, as a whole, has been carried on

through the publication of the training section in the Field Artillery Bulletin. The bulletin is published once a month and is sent to all Field Artillery officers. A number of officers have used this data in preparing for their promotion examinations and in most cases have been successful. During the past year there was a total of forty-seven promotions as compared with but only one during the year 1921. In addition to the special class at Fort Sill, there have been twenty-five Reserve Officers ordered to active duty for short periods during the past year; two of these officers are now on duty with the War Department General Staff and the remainder have been on duty with the different Corps Areas, working on the organization of the Reserve Corps.

IV. RESERVE OFFICERS' TRAINING CORPS

The Field Artillery Units of the Reserve Officers' Training Corps have continued to steadily develop and to increase their efficiency, enrolment and output during the past year. The attitude of the students who enter the courses has been marked by a greater appreciation of their purpose, character and value. At many institutions the mass of students can be reached only by constant and judicious propaganda and advertisement to bring the military work to their attention. The college authorities have greatly assisted in this, particularly in giving the military department the same standing and position as is accorded other departments in the institution, giving proper academic credit for the military courses, and granting satisfactory hours of instruction.

The results being obtained from these units is demonstrated by comparisons of yearly enrolment and output. Last year, one hundred graduates qualified and applied for commissions. The number this year has increased to three hundred. The enrolment in the first year of the advanced course (normally the junior year) in these units has increased from a maximum of 450 in last college year to a maximum of 660 at the end of the college year 1922–1923, and it is believed that this will be increased the next year to 900, which is approximately the maximum which can be expected from the present number of units. The enrolment in the two years of the basic course increased from 5000 last year to 6100 this year.

The 1921 Summer Camp was held at Camp Knox, Kentucky, from June 16th to July 17th. Eight hundred students from the units throughout the United States attended this camp, which was highly successful in every respect. In accordance with War Department policies, four 1922 Summer Camps for these units have been established and opened on June 15th for a period of six weeks. These camps are at Edgewood Arsenal, Maryland, for units in the

1st, 2nd and 3rd Corps Areas; Camp Knox, Kentucky, for units in the 4th, 5th, 6th and 7th Corps Areas; Camp Travis, Texas, for units in the 8th Corps Area (except the Colorado Agricultural College), and Camp Lewis, Washington, for units in the 9th Corps Area (and the Colorado Agricultural College).

The maintenance of a proper standard of instruction and the general success of the work are dependent upon an adequate instructional staff and sufficient appropriations.

A list of units and the course of instruction was submitted with the 1921 report. During the year just closed, constant effort was made to reduce the cost of this instruction to a minimum per student. The gratifying results obtained are shown in the following table:

The following items pertaining to the cost of maintenance of R.O.T.C. units are in the nature of a digest from the complete table submitted with the Chief of field Artillery's Report.

Harvard University:	176 students; average yearly cost per student (charged to R.O.T.C. appropriations) $86.64.
Yale University:	258 students; average yearly cost per student (charged to R.O.T.C. appropriations) $97.80.
Cornell University:	537 students; average yearly cost per student (charged to R.O.T.C. appropriations) $51.10.
Princeton University:	234 students; average yearly cost per student (charged to R.O.T.C. appropriations) $117.67.
Virginia Military Institute:	190 students; average yearly cost per student (charged to R.O.T.C. appropriations) $121.62.
Alabama Polytechnic Institute:	320 students; average yearly cost per student (charged to R.O.T.C. appropriations) $83.02.
Ohio State University:	557 students; average yearly cost per student (charged to R.O.T.C. appropriations) $43.45.
Purdue University:	1163 students; average yearly cost per student (charged to R.O.T.C. appropriations) $36.78.
Culver Military Academy:	102 students; average yearly cost per student (charged to R.O.T.C. appropriations) $141.14.
University of Chicago:	187 students; average yearly cost per student (charged to R.O.T.C. appropriations) $64.70.
University of Illinois:	630 students; average yearly cost per student (charged to R.O.T.C. appropriations) $30.79.

University of Wisconsin:	474 students; average yearly cost per student (charged to R.O.T.C. appropriations) $30.83.
Iowa A & M College:	316 students; average yearly cost per student (charged to R.O.T.C. appropriations) $46.58.
University of Missouri:	354 students; average yearly cost per student (charged to R.O.T.C. appropriations) $49.23.
Colorado Agricultural College:	312 students; average yearly cost per student (charged to R.O.T.C. appropriations) $60.91.
Texas A & M College:	231 students; average yearly cost per student (charged to R.O.T.C. appropriations) $105.79.
University of Oklahoma:	349 students; average yearly cost per student (charged to R.O.T.C. appropriations) $49.59.
Leland Stanford University:	162 students; average yearly cost per student (charged to R.O.T.C. appropriations) $113.79.
Oregon Agricultural College:	288 students; average yearly cost per student (charged to R.O.T.C. appropriations) $91.97.
University of Utah:	174 students; average yearly cost per student (charged to R.O.T.C. appropriations) $65.28.

V. NATIONAL GUARD—FIELD ARTILLERY

The progress made by the National Guard during the past year has been most satisfactory. There are now three hundred and seventy-six Batteries (Headquarters, Gun, and Service), and fourteen hundred and ninety-one officers, that have been federally recognized. This is a gain of one hundred and sixty-nine Batteries and six hundred and fifty-nine officers since I submitted my report for the fiscal year 1921.

The officer personnel, in most instances, is made up of qualified field artillerymen, many of whom saw service in the World War, either as an officer or as an enlisted man. It is very noticeable that during the past year many officers who have been federally recognized were commissioned officers during the war. All the officers are being technically classified by the Personnel Section of this office and a permanent record is being made for each. This record shows the educational qualifications, business experience, the duties each officer performed while in the military establishment, the manner in which he performed them, and the remarks and recommendations of his superior officers. When orders are issued for

mobilization, it will be an easy matter to select the many specially qualified officers that are invariably needed for particular duties that will arise.

There are still many obstacles to be removed before the National Guard, Field Artillery, reaches the desired standard; the most important are: Shortage of regular Army officer instructors, shortage of regular Army sergeant instructors, animals and armories. I am reducing the shortage of instructors as fast as suitable officers and men can be made available for this duty, but, as for the animal and armory shortage, that can only be eliminated by an increase in the funds allotted for these purposes.

All the reports on the training of the National Guard units, both in the armories and the summer training camps, have been encouraging. Besides the officers regularly assigned to duty with the Guard, there are being sent to each summer training camp sufficient numbers of regular officer instructors to carry out the training schedule.

In November, 1921, a class of nineteen national guard officers reported to the Field Artillery School, Fort Sill, Oklahoma, for a special course of instruction, which lasted six weeks. All of these officers completed the course satisfactorily with the exception of seven. One of these seven officers was found deficient in service practice alone, one in gunnery, and five in both service practice and gunnery.

One of the methods now used to keep the guard officers informed as to the developments in the Field Artillery is the publication by this office of the Field Artillery Bulletin, which contains both an information and a training section. This bulletin is sent to all Field Artillery Officers.

The recent legislative restriction by Congress, that no more motorized units be created, is highly unfortunate and will inevitably retard the development of the most effective field force.

VI. DEVELOPMENT OF GUNS AND CARRIAGES

During the year this office has coöperated with the Ordnance Department in developing new and better guns and carriages. The development of any particular piece of Ordnance is the work of years, and should therefore always be going on, in time of peace, as an essential measure of preparedness. Money for such development and experimental purposes is well spent. When war is imminent, it is too late. The following is a brief resumé of the results accomplished:

GUNS AND CARRIAGES

a. Seventy-five-mm. guns and 105 howitzer carriages: A carriage (of the split-trail type), Model 1920, was constructed with a

view to complete interchangeability with either the 75-mm. gun or the 105 howitzer. One of these carriages is now under test at Camp Bragg, N. C. The price paid in weight and complication is, however, probably too great for the advantages of interchangeability.

b. Seventy-five-mm. carriage, Model 1921 (box trail): This carriage, now undergoing test at the Ordnance Proving Ground, is designed as the answer to the best carriage that can be designed for this calibre of gun, bearing in mind simplicity and use of commercial forms of steel as far as practicable.

c. One hundred and five-mm. howitzer carriage, Model 1921 (box trail): This, like the carriage just mentioned, illustrates the best that modern practice can offer in a carriage designed for a single type of weapon. When this carriage has, like the previously mentioned one, undergone its Ordnance test, both will be sent to the Field Artillery for further service tests.

d. Pack howitzer and carriage, Model 1920: The pilot is now with the 4th Field Artillery at Camp Stanley, Texas, undergoing a service test. If successful, it will be a great improvement over our present practically obsolete Vickers-Maxim Mountain Gun. The tests, so far, have suggested still further improvements, which are being incorporated in a redesign.

e. Designs of other and larger guns and howitzers, at present being worked out by the Ordnance Department, give promise of great improvement over present weapons.

MOTOR CARRIAGES

a. The following matériel having been tested at the Ordnance Proving Ground has been or will be sent to Fort Sill, Oklahoma, for further test by the Field Artillery:

Motor Carriage, Mark VI (Holt), mounting either a 75-mm. gun or 105 howitzer.

Christie Motor Carriage, mounting the same matériel. (These carriages are both heavier than is desirable for matériel of this type and have developed various defects. However, they offer a very promising field of study, both from the technical and tactical point of view.)

Mark IX (Holt) motor carriage, mounting either a 155-mm. gun or 8-inch howitzer, is undergoing test at the Ordnance Proving Ground.

TRACTORS

The 2½-ton (Cleveland): This tractor, embodying the principle of flexibility of track, is under test at the Ordnance Proving Ground.

The 2½-ton, Model 1918 (Cadillac Motor): There are over one hundred of these on hand. They have never been successful, having been hastily designed during the war. Attempts to improve them are now being made along two separate lines. One is to increase the radiating surface, and also to use an oil radiator, and the other is to substitute a Class B motor for the Cadillac. Both of these experiments are very promising.

VII. MOTORIZATION OF FIELD ARTILLERY

There has been no change during the year in the motorization of the heavier calibres of guns and howitzers. These could not under any circumstances be economically drawn by animals. Results of the experiment of substituting tractors for horses on the lighter calibres are still inconclusive, and, unfortunately, the experiments had to cease during the past year, due to inability to secure sufficient funds to transfer this motorized equipment to active regiments. The sum needed for this transfer was pitifully small compared to the importance of the experiments.

There still exist wide differences of opinion in the Field Artillery Service as to the value of tractors as motive power for use with divisional light artillery. Much effort must be expended to make newer models of tractors more reliable in their performance than the tractor now on hand, and it is most necessary that active work with motorized units be continued to develop the proper organization of this type of artillery and to insure improvement of matériel.

Considerable study has been given the question of the use of commercial tractors by the Field Artillery in time of emergency. It is apparent that in a war of any magnitude, we shall be forced through lack of sufficient tractors of military design, to adopt vehicles of commercial types which can be secured in quantity. Accordingly, a study of the commercial tractor field has been made in conjunction with the Ordnance Department, with a view to listing such tractors as are suitable for this use. In the selection of types from the commercial field, not only is there being considered the mechanical suitability of the tractor for military purposes, but also due weight is given the question of availability in quantities. At present two different makes of commercial tractors are under test at the Ordnance Proving Grounds, and three other types will shortly be purchased. After the technical or engineering test by the Ordnance Department, it is contemplated, equipping one battery with these commercial tractors, to determine their actual value from the artilleryman's point of view as a substitute for animals.

In addition to the question of efficiency and reliability of a tractor, there is always present in time of peace, the further question

of cost of operation and maintenance. Accordingly, daily records are being kept at Camp Bragg, N. C., not only of the tractors, but of all other automotive vehicles operated there, with a view to preparation of cost sheets, based on actual experience.

TRACK MECHANISMS

Several forms have been under test at the Ordnance Proving Ground, notably the Chase fabric track for light vehicles, applied to the Dodge light repair truck; the Chase heavy track constructed of steel cables under test on the Militor truck; and the Christie adaptor applied to the Mack commercial truck. The subject of track mechanisms is one in which the Field Artillery is vitally interested, as it has a great influence upon the question of motorization of Field Artillery.

AMMUNITION

Many improvements have been made in ammunition during the year.

It will be noted that the development work herein briefly touched on is taking place in the Ordnance Department, and will, accordingly, be more fully covered in the Report of the Chief of Ordnance. It is mentioned in this report as it is being done for the Field Artillery, which is the using service. I cannot speak too highly of the excellent spirit of coöperation on the part of the Chief of Ordnance and his entire Department. Their whole attitude is to design and develop what the Field Artillery requires.

VIII. TRAINING (ORGANIZATIONS)

The training of all Field Artillery organizations, with the exception of those stationed at Camp Bragg, N. C., and Fort Sill, Oklahoma, was carried on under the direct supervision and control of the Corps Area and Department Commanders. All training in the United States was handicapped by the transfers and consolidations incident to the reorganization of the Army necessary to meet the restricted strength of personnel prescribed by the Appropriation Act of 1921, by the shortage of Field Artillery officers and by the great amount of fatigue duty. However, during the months of October and November, a condition of partial stability was reached, recruits were obtained in sufficient numbers to fill all organizations to operating strength, and artillery training was energetically undertaken with excellent results. Inspections by the Chief of Field Artillery or his assistant, and a study of the target reports covering the period January 1, 1922, to the date of this report, indicate a much higher

condition of efficiency in Field Artillery organizations than has previously existed since the war. All organizations are considered ready for Field Service insofar as proficiency in training is concerned.

I am glad to note that the system of employing a single training battery for the instruction of the National Guard, Organized Reserves, C. M. T. C. and R. O. T. C. at Corps Area Training Centres is being abandoned. At least a battalion should be available for this important duty in each corps area and this should be reënforced during the summer training period by the detail of other available regular organizations and commissioned instructors drawn from the student personnel at the Field Artillery Schools and from the Officers' Reserve Corps. It is important that the organization of such battalions of divisional artillery as are used as training troops should be changed by substituting a tractor-drawn 155-mm. howitzer battery for one of the 75-mm. batteries. Such an organization would not only be better for training purposes, but would provide a means for familiarizing the regular personnel with the technical and tactical handling of this important matériel. It would also provide both for prompt expansion in a major emergency and for a balanced armament in minor operations.

Training was handicapped to a considerable extent by the poor condition of animals due to the reduced forage ration necessitated by insufficient funds.

Training with the heavier calibres, or Corps Artillery, has gone forward at Camp Bragg, North Carolina, with satisfactory progress. This training, I regard as most important. The lighter guns have been in the Field Artillery during the entire life of every officer now in the Army. The heavier guns are a more recent acquisition, whose importance was fully brought out by the World War. Being thus newer, their handling is not so well understood, and hence the importance of familiarizing the Field Artillery officers with both the technic and tactics of these weapons. With the small number of these guns in service, under reduced strength, this familiarity can best be obtained by rotating officers for duty with the Corps Artillery Brigade.

The 1st Battalion, 83rd Field Artillery, a motorized 75-mm. organization, has served as a demonstration battalion at the Infantry School, Fort Benning, Georgia.

This battalion has done excellent work demonstrating the tactical handling of divisional artillery, and the firing normally done by such artillery in the support of infantry. In addition to the above, this

battalion has carried on valuable experimental work relative to developing the organization and matériel desirable for tractor-drawn light artillery.

IX. COMMISSIONED PERSONNEL—ACTIVE

On June 30, 1922, there were 1251 officers in the Field Artillery Arm, distributed as follows;

	Colonels	Lt. Colonels	Majors	Captains	1st Lieuts.	2nd Lieuts.	Total
Duty F. A. Organizations	10	15	72	359	373		829
Instructors, F. A. School	1	3	29	25	16		74
Army War College	3	2	1				6
School of the Line and General Staff School	2	7	34				43
Students Civilian Colleges			1				1
R. O. T. C. Units			27	43	14		84
National Guard		1	22	24	2		49
U. S. Military Academy			18	5	1		24
Military Intelligence Division		2	8	9	1		20
Camp and Detachment Headquarters		1	1				2
Office Chief of Field Artillery and Field Artillery Board	1	2	11	3			17
General Staff	8	9	9	1	1		28
Organized Reserves	1	7	10	3	1		22
Inspector General's Department	1		1				2
Ordnance Department			2				2
Signal Corps				2			2
Air Service			1	1	2		4
Aides-de-Camp					3		3
Instructors, Infantry School			1				1
American Forces in Germany			1	6	4		11
Unassigned Graduates, U. S. M. A., 1922.						23	23
Sick				3	1		4
Totals	26	50	249	484	419	23	1251

The above table shows but a limited number of officers on duty with the Organized Reserves, and far below the Field Artillery quota with the National Guard. A steady effort is being made to lessen

these shortages, and considerable progress has been made in this direction during the past year. However, as long as the Field Artillery remains as far below its authorized strength as it is at present, it is difficult to make real progress without serious curtailment of the number of officers on other important and necessary duties.

In my opinion, the most serious problem confronting the Field Artillery today is the procurement of officers. All activities and organizations within the arm as well as the Field Artillery representation with all the various activities outside the arm, are suffering from the lack of properly qualified and trained Field Artillerymen. With this condition before me, I have encouraged the transfer of any officer, whose record warrants, to the Field Artillery. A total gain of forty (40) officers has been the result during the past year. Another measure used to increase the commissioned strength of my arm was to obtain the consent of officers of other arms to accept a four-year detail in the Field Artillery. With this object in view, I secured the permission of the Chiefs of Infantry, Cavalry and Coast Artillery to approach certain officers of their arms with the idea of gaining their consent to accept a detail of four years in the Field Artillery. I communicated with about twenty of these officers with a net gain of but two lieutenant colonels.

The War Department, realizing the acute shortage of officers in the Field Artillery, then directed the Chiefs of Infantry, Cavalry and Coast Artillery to submit lists of colonels and lieutenant colonels who could be made immediately available for detail in, and duty with, this arm of the service. From these lists I was authorized to select twelve officers who would be detailed for a period of four years. Of those selected, but nine were so detailed.

It appears, as a result of these only partially successful attempts to augment its commissioned strength, that the Field Artillery must depend on the appointment of second lieutenants to fill its quota. Unless the results are more promising than during the past year, this will require several years, as only eighty-seven (87) officers were originally commissioned in the Field Artillery during the year ending June 30, 1922, twenty-seven (27) of whom were graduates of the Military Academy and sixty (60) of whom were appointed as a result of examinations held for civilian and enlisted candidates.

I desire to repeat the statement, contained in my last report, as to the necessity of obtaining the full quota of commissioned personnel for this arm. The only permanent personnel in the Army is the commissioned personnel. Enlisted men come and go. The efficiency of the Army depends upon its commissioned officers. These must be adequate in number. This condition does not prevail in the Field Artillery today.

COMMISSIONED PERSONNEL (CLASSIFICATION OF ACTIVE PERSONNEL)

The work of the Classification Section, Commissioned Personnel, has been continued along the same lines as detailed in my report of September 10, 1921. With twelve exceptions, the records of all officers have been brought up to date and the file of Field Artillery specialists completed. A very essential element in the evaluation of an efficiency report is the determination of the rating equation of the reporting officer, and detailed studies with this end in view have been satisfactorily continued.

The information regarding the qualification of officers, which this section furnishes, continues to be of great value, and is used constantly in making selection or assignment for particular duties.

There are twelve officers whose records, up to and including June 30, 1921, have not been completed due to the fact that all efficiency reports on them have not been received from the Adjutant General. It is hoped that continued effort will be made to have reports rendered promptly, thus obviating incomplete records extending over periods as far back as those noted above.

Improvement has been noted in this office in the care and thoroughness with which efficiency reports are made out. This is attributed directly to the policy of educating the officer personnel regarding the use and importance of these reports. It is believed that further work along this line will be of great value.

X. WAR PLANS—FIELD ARTILLERY

The War Plans section was organized in April, 1921, to take charge of and prepare corresponding Field Artillery studies on the various War Plans then being prepared by the General Staff. Since these plans and studies involved a study of Organization, Operations, Supply, etc., this section was added to the Operations Section of the Office of the Chief of Field Artillery as a Sub-section in October of 1921. Prior to the World War, no plans for the mobilization, equipping or training of the Field Artillery under an emergency were in existence and consequently much valuable time was lost in preparing the preliminary plans for the Field Artillery at the beginning of the World War. In the preparation of the various Field Artillery plans and studies it is my intention to have these plans worked up for all training centres, replacement depots and schools which will be necessary under each plan and to cause plans to be kept up to date and ready to be put into effect at a moment's notice.

Based upon the above ideas, the War Plans prepared by the War Department General Staff have been studied and the Field Artillery plans to conform thereto have been prepared to cover

various emergencies from a minor one to a maximum one. The details of these respective plans have been carefully prepared and worked out at length even to the selection of instructors for the different schools, training centres and replacement depots, and the assignment of Regular and Reserve Corps personnel to other specific duties. The preparation of the necessary orders in blank covering these individual officers and their particular assignment to duty has been made. The preparation of these studies, now in time of peace, based upon the records of Regular and Reserve Officers during the World War permits of each officer's record being examined in detail and the final selection of the officer for the particular duty which his war training and experience has best fitted him to perform during another emergency. This will prevent any wasting of personnel by assigning officers, either of the Regular Army, National Guard or Organized Reserves, to duties which they are professionally unsuited to fill.

Due to the secret and confidential nature of all the different War Plans prepared by this Section of the Office of the Chief of Field Artillery, it is not possible to go further into the scope and details of these plans.

XI. THE FIELD ARTILLERY BOARD

This Board has continued to function satisfactorily during the year. It has, among other activities, completed tests and submitted recommendations on the following more important items of equipment and matériel:

a. Ordnance Matériel:

1. New type panoramic targets.
2. Design of "Mechanical range tables" (an important mechanism to facilitate application of corrections of the moment).
3. Fire control equipment.
   Special plotting scales,
   Wind component indicators,
   Lighting device for sights, etc.
4. Automotive equipment.
   Test of motor carriages (still in progress),
   Chase track on Ford car,
   Modification of tractors to increase reliability,
   A detailed study of the problem of automotive vehicles for Field Artillery,
   Study of adaptability of commercial tractors to military purposes.

5. Use of lock washers with fuses.
6. Special drill cartridges.
7. Special rubber tires for 155 howitzers.
8. Study of equipment and basic allowance tables, including revision of those presented by the Matériel Section of the office of the Chief of Field Artillery.

b. Signal Corps Matériel:

1. Test of wire, reels, and special telephones, including telephones for gas masks and anti-noise transmitters for artillery.
2. Galitzka panels for airplane communication.

c. Quartermaster Corps Matériel:

1. Special collar pads for artillery harness.
2. Containers for gasoline in motorized units.
3. Kit bag for issue to troops.
4. Special clothing of new types.

d. Medical Corps Matériel:

1. Veterinary equipment for stable sergeants.

It has in addition, considered several hundred items of minor equipment and has done considerable research work.

XII. THE TRAINING REGULATIONS BOARD

Due to the great amount of work before the Field Artillery Board, it was decided to convene a special Training Regulations Board, in order to expedite rewriting of regulations. This Board has made satisfactory progress on the new series of Field Artillery Training Regulations, the need for which to relieve the present confusion is pressing. Work was concentrated on those sections most imperatively needed and of these several have already been published and distributed; including "Service of the Piece, 75-mm. Guns, Models 1897, 1916, and 1917," and "Service of the Piece, 155-mm. Howitzer." "Field Artillery Firing," the most important pamphlet of the series, has also been completed and has been forwarded to the Adjutant General of the Army for publication.

During the World War, our Field Artillery literature fell into great confusion. Information needed by the arm became badly scattered—a little in one book and a little in another. Some books were out of harmony with others, and in a few cases, there was positive contradiction. Some of the literature was in English and some in French. Some ideas were in accordance with American

practice and ideals, and some were not. All of these troubles, it is anticipated, will be relieved during the present fiscal year, when it is anticipated this Board will complete its work.

XIII. FIELD AND COAST ARTILLERY

From time to time since the Armistice, recommendations have been made to the War Department looking to a combination of the Coast and Field Artillery or recommending a different line of demarcation between the two arms from that set forth in Sections 3 and 4, of the Act of Congress, approved January 25, 1907, which established these two arms of the service. The study by the War Department of these various recommendations and the fear of an approval of some of them have caused a considerable amount of anxiety and unrest among the officers of Field Artillery. This year has seen a definite decision by the War Department on this subject published August 1, 1921, in Section 5, of General Orders, No. 36. This decision in effect adheres strictly to the definitions of the two arms in the Act of January 25, 1907, and has entirely relieved the anxiety of the officers of Field Artillery. It is not inappropriate to state that in discussing the question of the proper line of demarcation between the Field Artillery and the Coast Artillery with a considerable number of Field Artillery officers, that without exception the Field Artillery officers who have discussed this question with me are of the opinion that the decision published on August 1, 1921, is entirely sound. In this connection it is desired to call attention to the opinion of the General of the Armies on this subject as expressed on page 1528, Hearings before the Committee on Military Affairs, House of Representatives, 66th Congress, 1st Session, on Army Reorganization, Volume I; the opinion of the Chief of Field Artillery, as expressed on pages 1255 to 1260 of the same volume; and the opinion of the Chief of Artillery, A.E.F., as expressed on pages 387 to 391 of the same volume. This question having been decided along lines eminently sound, it is believed desirable that it be not reopened.

XIV. MISCELLANEOUS

This office is represented by one of its members at meetings of the Technical Committees of the Quartermaster Corps, Signal Corps, Ordnance Department, Engineer Corps and Chemical Warfare Service. Such procedure is of mutual benefit.

At least half of the work of this office is done for the General Staff Corps. This includes such items as the compilation of Tables of Organization, Tables of Basic Allowances, Tables of Equipment, etc.

This office is represented at the Ordnance Proving Ground at Aberdeen by a field artillery officer stationed there. Among the more important tests which he has witnessed or participated in are the following:

Tractors:
- Cleveland.
- Aberdeen.
- Fordson with Bates attachment.

Self-Propelled mounts:
- 75 mm. Mark VII.
- 75 mm. Mark VI.
- 75 mm. Christie.
- 105 mm. Mark VI.
- 105 mm. Christie.
- 155 mm. Mark IX.

Guns and Carriages:
- 75 mm. Split Train Model 1920.
- 75 mm. Box Trail Model 1921.
- 105 mm. Split Trail Model 1920.
- 105 mm. Box Trail Model 1921.
- 75 mm. Pack Howitzer.
- Infantry Howitzer.
- 3.3 English 18 pounder.
- 155 mm. Trench Mortar Model 1920.
- 240 mm. Free Recoil Howitzer.
- Track Motor Carriage.
- Dodge 6 wheel Chase Track.
- Dodge 8 wheel Chase Track.
- Ford 8 wheel Chase Track.
- Militor 8 wheel Cable Track.
- Dodge 8 wheel Cable Track.
- Ammunition Carts Chase Track.
- Reconnaissance Carts Chase Track.

Projectiles and Powders:
- 75 mm. light and heavy for 1920 gun.
- 105 mm. for 1920 Howitzer.
- Various shaped and weighted projectiles for ballistic qualities.
- Infantry Howitzer armor piercing projectiles.
- Picantinny and Du Pont Flashless, Smokeless and Non-Hygroscopic Powders.
- Test of War Reserve ammunition, which included lots of all makes of ammunition and component parts thereof.

Machine Guns:
- .50 calibre, with armor piercing projectiles.

The Chief of Field Artillery is represented at the Chemical Warfare Proving Ground at Edgewood Arsenal, Maryland, by a field

artillery officer who is stationed there. He has coöperated with the Chemical Warfare Service in the preparation and execution of proof programs and experimental work dealing with field artillery chemical ammunition. He has furnished or obtained such information concerning field artillery subjects as has been desired. The work has concerned principally the development of suitable boosters for the field guns and howitzers. In addition, the field artillery has maintained at Edgewood Arsenal, a field artillery detachment consisting of one lieutenant and twenty men. This detachment has had the care and maintenance of all artillery matériel there and has performed all the firing called for under proof programs and demonstrations.

WM. J. SNOW,
Major General U. S. Army,
Chief of Field Artillery.

SOME REMARKS ON MOUNTAIN ARTILLERY*

BY A. MORTUREUX, CAPTAIN OF ARTILLERY, FRENCH ARMY

REVUE D'ARTILLERIE, AUGUST, 1922

CHAPTER V

DESCRIPTION OF MOUNTAIN GUNS OF THE MOST RECENT TYPE

IN a study on the "Evolution of Mountain Guns," which appeared in the *Revue d'Artillerie,*[1] Captain Amenc gave the principles of construction and the description of mountain guns in existence before 1914.

As a continuation of that work, we now wish to give a description of the following recent guns:

1st. Schneider guns: The 75-mm. gun and the 105-mm. howitzer, 1919 model;

2nd. Skoda guns: The 75-mm. gun, 15 model, and the 10-cm. howitzer of the 16 model;

3rd. English 3.7-in. howitzer (94 mm.), 1918 model[2];

4th. The American 75-mm. gun, 1920 and 1922 models.

We shall also say a few words about an older gun constructed by the Saint-Chamond firm, the 75 P/110/4, which was used by the Belgians in the conquest of the German colonies in Africa.[3]

1ST. SCHNEIDER MOUNTAIN GUN

The guns constructed in 1919 by the Schneider firm comprise a 75-mm. gun and a 105-mm. howitzer. These guns therefore actually form a type of mountain artillery such as we have already described (gun and howitzer), the similarity of which makes easier the training of the gun crews, the collecting of spare parts and repairs.[4]

The principal characteristics of these guns is their high power; the latter, as a matter of fact, surpasses all results obtained up to the present time. We have succeeded in obtaining:

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* Translation by courtesy of Military Intelligence Division, General Staff, U. S. Army.

[1] Volume 82, July 1913, page 207.

[2] England is said to be considering a new mountain gun at present, a 3-inch (76.2 mm.) gun, about which we have no information. It is probable that the regulation 2.75-inch (69.8 mm.) gun, firing a projectile of 5.670 kg. (210 gr. of explosive) is not considered powerful enough.

[3] See the work of the Belgian, Major Furst, entitled "Colonial Artillery (Artillerie coloniale), Paris, Chapelot.

[4] Modern principles of the interchangeability of pieces and of standardization have been applied in the construction of these guns.

For the 75-mm. gun { A *muzzle energy* of 60 ton-metres and a maximum range greater than 9 km. (with the D shell).

For the 105 gun (howitzer) { A muzzle energy of 75 ton-metres and a maximum range of about 8 km.

These high values for the power of the guns is obtained at the same time as the following characteristics: great stability of fire; strength; simplicity of the mechanism and construction of the whole piece; a rate of fire which may reach 20 rounds per minute in the case of the gun (cannon); and a very satisfactory mobility.

As far as general construction is concerned, the guns of the 1919 model contain the same mechanism or devices found in the older models of Schneider mountain guns; but these devices in the construction of the guns, which had already received the approval of a long experience, had also been tested in the great war and undergone improvements which were the results of both hard and lengthy tests.

From 1902, the time when the Schneider hydropneumatic recuperator with glycerine replaced the spring recuperator, until the eve of mobilization, the Creusot factories built a large number of different models of mountain guns, each one of which naturally profited by the experience of its predecessors.

The following table only gives those models which were successively adopted by one or more of the powers and constructed on a large scale for the use of their mountain artillery; it also contains the essential data of these same models; some of them, moreover, were not adopted until after they had successfully competed with their competitors of foreign make, chiefly the Krupp and Skoda guns, in the difficult competitive tests, especially in Spain, Greece, Turkey, Russia, etc. It would be interesting to review in detail the tests to which they were subjected, but that would be deviating from the subject under discussion in this article. And moreover, the *Revue d'Artillerie* has contained lengthy articles on these tests.[5]

We shall merely add that a comparatively great number of these guns (especially the Russian, Serbian, Italian, Roumanian, Greek,

[5] See in particular: "Essais en Gréce pour le choix d'un canon de montagne" (Tests held in Greece for the Selection of a Mountain Gun), volume 71, March 1908, page 353; "Le Réarmament de l'artillerie portugaise" (The Rearmament of the Portuguese Artillery), volume 72, May 1908, page 89; "Concours de matériel en Turquie" (Competitive Tests of Guns in Turkey), volume 77, October 1910, page 25; "L'Evolution de matériel de montagne" (The Evolution of Mountain Guns), volume 82, July, 1913, page 228.

TABLE OF THE PRINCIPAL MODELS OF SCHNEIDER MOUNTAIN GUNS
Adopted by the different powers since the hydropneumatic brake has been in use.

Designation of the gun	Year of test	Powers to which it has been furnished	Weight of the projectile	Initial velocity	Weight of the piece in battery	Number of packages	Maximum range with shell of		Muzzle efficiency.
							Ordinary shape	Optimum shape	
			kilog	*metres*	*kilog*		*metres*	*metres*	*ton-metres*
75 M.A. and M.A.$_2$	1902	Bolivia, Morocco China, Peru	5	300	450	5	3,900	4,500	51.1
70 M.D.	1903	Spain, Portugal	5.3	300	520	5	4,000	4,700	46.7
75 M.D.	1903	Peru	5.1	300	511	5	3,950	4,100	45.8
75 M.C.	1903	Bolivia, Cuba	5.	300	494	5	3,900	4,500	46.4
75 M.C.$_2$	1904	Bulgaria	5.1	330	500	5	5,200	6,600	56.8
70 M.D.$_2$	1904	Serbia	5.	300	513	5	4,800	5,700	44.7
75 M.P.C.	1906	Morocco	6.5	350	600	6	5.000	5.800	67.7
75 M. P. D.	1906	Greece	6.5	350	616	6	5,000	5,800	63.8
75 M.P.C.$_2$	1907	Bolivia	6.5	350	626	6	5,800	6,900	64.8
75 M.P.C$_2$. *bis*	1907	Russia	6.5	350	630	6	5,900	7,000	67.7
75 M.P.D$_1$	1908	Montenegro, Peru, Serbia	6.5	350	626	6	6,050	7,200	64.9
76 M.C$_5$	1910	Italy	5.3	375	512	5	5,800	7,300	74.2
75 M.P.C$_4$	1910	Serbia	6.5	350	645	6	6,600	8,100	63.0
75 M.D$_2$.T.	1911	Turkey	5.3	300	513	5	4,900	5,900	47.4
75 M.P.C$_2$ *ter*	1912	Roumania	6.5	350	632	6	5,900	7,000	64.3
75 M.P.C$_7$	1912	Greece	6.5	350	635	6	5,000	5,800	64.0
75 M.P.E.[1]	1913	French colonies	7.240	330	600	6	5,800	6,600	67.0
75 S.M.P.	1919	Chile	6.5	425	670	6 or 7	7,500	9,500	89.5
Ob. 105 S.M.	1919	Chile, Spain	12	350	740	7 or 8	7,100	8,100	100

[1] This gun was adopted in 1914 by the Minister of the Colonies, but its construction was interrupted by mobilization.

Turkish, Bulgarian, etc.) were used in the European War on the different eastern fronts.

(A) *The General Construction of the Guns of the 1919 Model*

The general construction of these guns, except for the equipment and devices essentially peculiar to service in the mountains and those for transportation on the back of mules, is practically the same as that of the different Schneider field guns on wheels.

A *barrel* attached to a sledge which recoils with it during the firing on a chassis which oscillates for elevating the gun; a breech screw which opens and closes quickly by a single continuous movement of a lever, the latter of the socket-type in the case of the regular gun, and with a plastic obturator in the case of the howitzer.

The *sledge* of forged steel containing parallel to each other the brake and the recuperator and recoiling with the barrel; the rods of the two above-mentioned enclosed parts alone remaining motionless, attached to the front of the chassis.

The *chassis* serving as a guide to the sledge and projecting for a greater or lesser distance to the rear for that purpose; it also has the elevation sector.

The *carriage* moving on an axle, with the trail cut out to allow for the passage of the gun while recoiling and during elevation. On its rear end is an anchoring spade composed of two parts, one, firmly attached, narrow and very strong, to be reserved for use when firing on a rock, the other, broad and removable, for firing on less resisting terrain.

The *brake-recuperator* of the general Schneider model, that is to say, the hydraulic brake, in which glycerine is used as a liquid and which has a practically constant effort and a long recoil stroke, and a hydropneumatic recuperator with glycerine liquid identical to that of the brake and with reservoirs of compressed nitrogen (or, if there is none, of air). The recuperator is absolutely independent of the brake; it is very flexible, thanks to the great capacity of the nitrogen tanks, to the absence of a separator between the gas and the liquid and to the very low total value of the recoiling friction.

Thanks to the simplicity of its construction and to the ease with which it can be inspected, and its parts, joints, pistons, valves, etc., can be replaced, it has always been easy to keep the Schneider sledge in good working order, in spite of the intensity of the firing executed. Ordinarily the maintenance of this part in good working condition has been assured on the front, even in battery position, especially in the Balkans, by the use of the tools, spare parts and the personnel of the unit.

The inspection and disassembling operations can, moreover, be accomplished with still greater facility in the case of a mountain gun

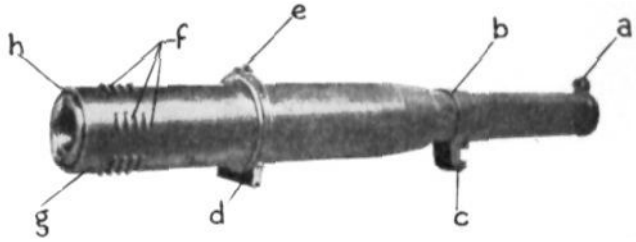


FIG. C.—THE 75 MOUNTAIN GUN, SCHNEIDER MODEL 1919 (TUBE)

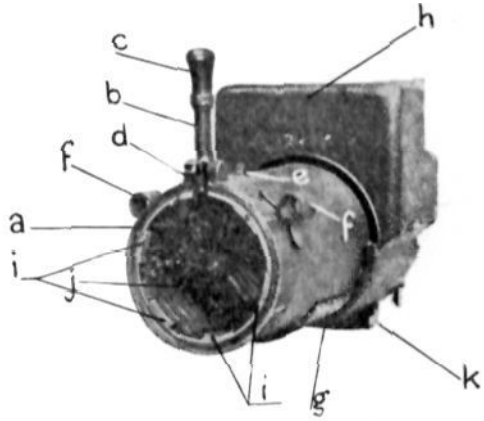


FIG. D.—SLEEVE

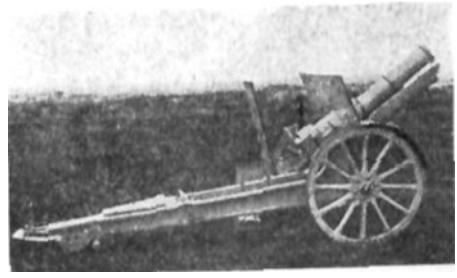


FIG. E.—SCHNEIDER 1919 MOUNTAIN HOWITZER

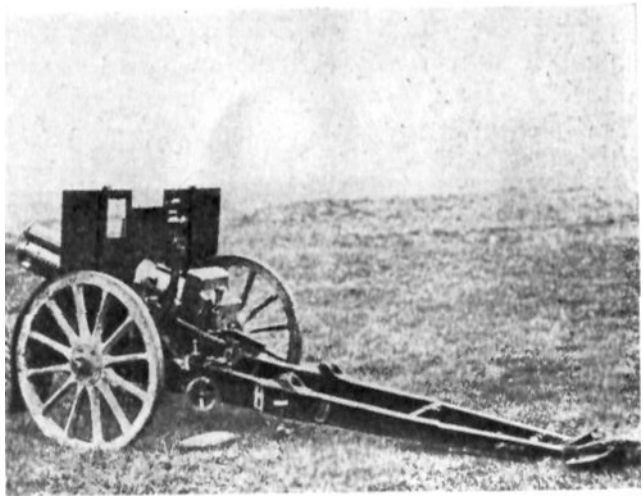


FIG. F.—75 SCHNEIDER MOUNTAIN GUN, MODEL 1919 (AXLE LOW)

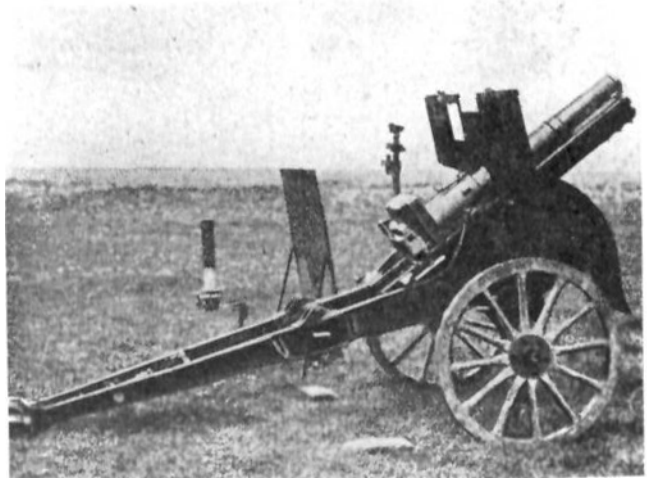


FIG. G.—75 SCHNEIDER MOUNTAIN GUN, MODEL 1919 (AXLE HIGH)

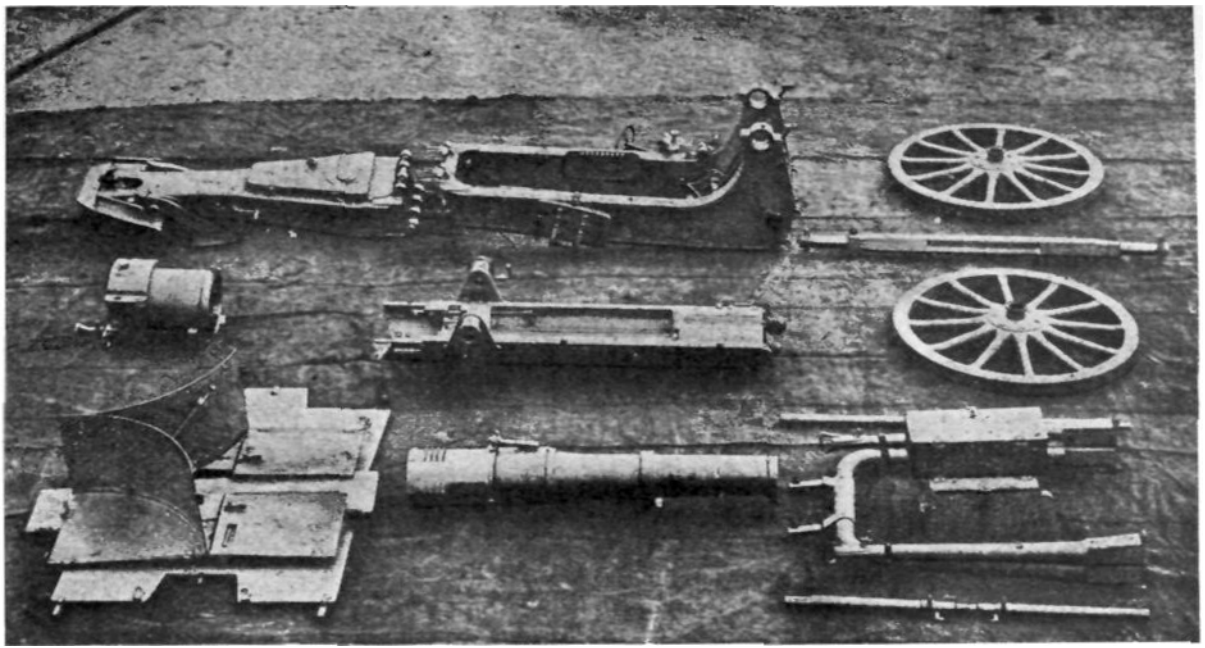


FIG. I.—DIVISION OF 105 SCHNEIDER HOWITZER, MODEL 1919, IN PARCELS

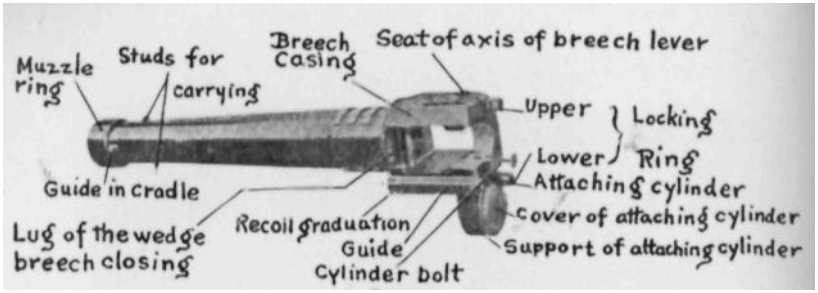


FIG. K.—75 SKODA MOUNTAIN GUN, MODEL 15 (TUBE)

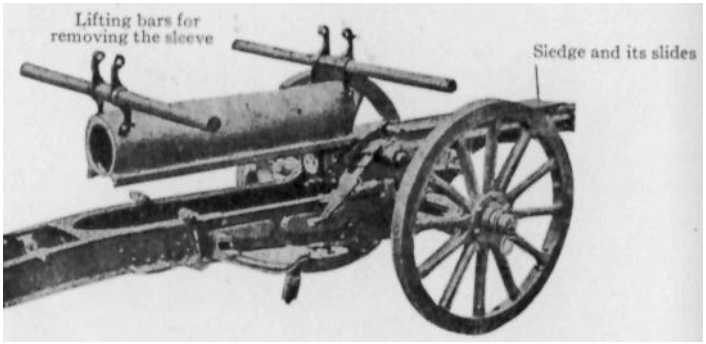


FIG. L.—PUTTING THE SLEEVE (MANCHON-LEST) IN POSITION

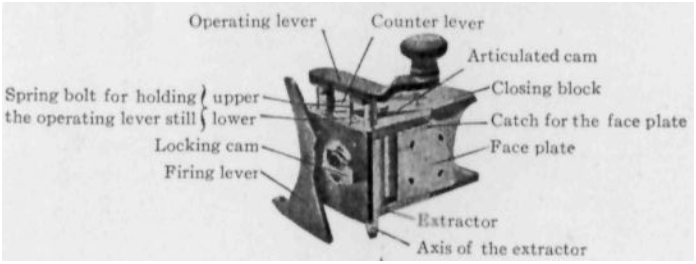


FIG. M.—BREECHBLOCK

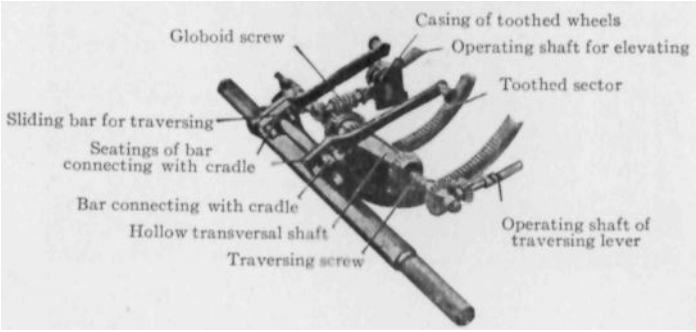


FIG. P.—AIMING DEVICE

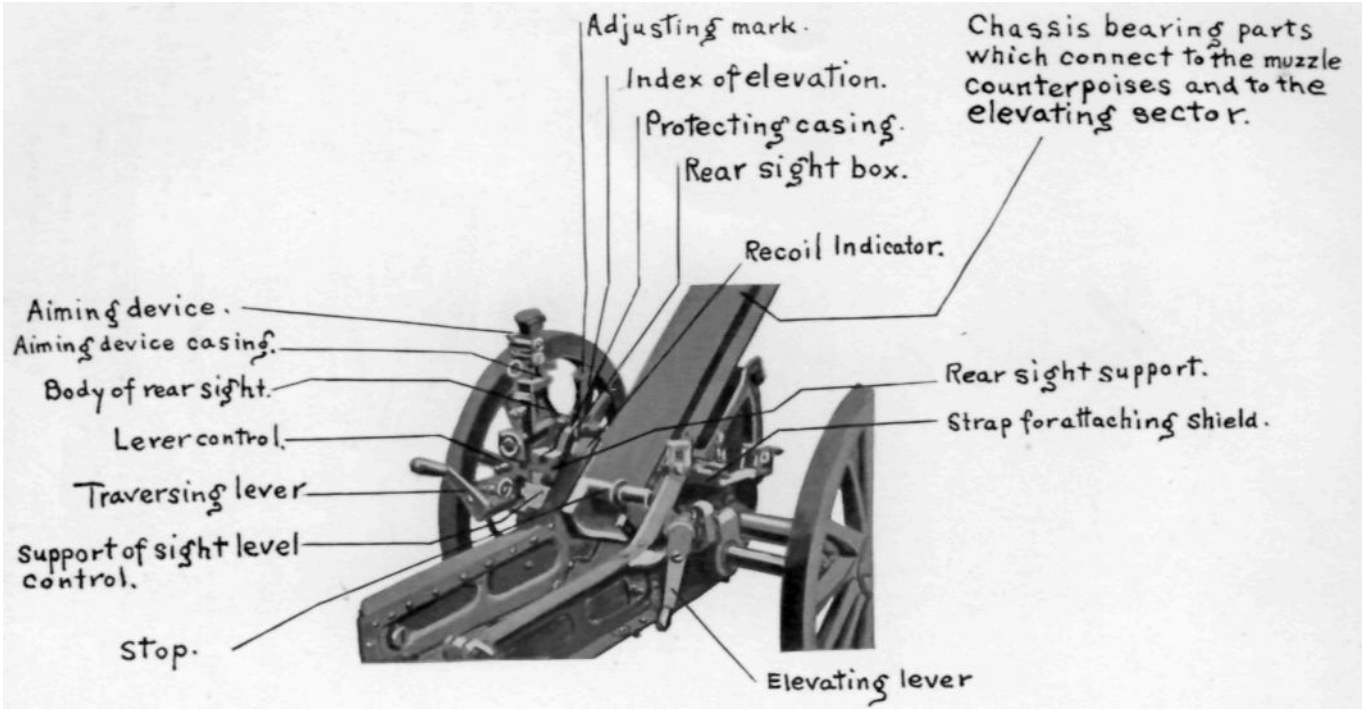


FIG. N.—GUN CARRIAGE

on account of its light weight, which makes it possible to do without a hoisting device of any kind.

Laying.—The carriage is made to slide on the axle (of square cross section) by the turning of an endless screw on the carriage which engages with a series of cogs cut into the rear face of the axle.

The extent of this sliding motion has been greatly increased as compared to that on former guns. In the case of the cannon (gun), the limit of traversing for gun-carriage reaches 10º, that is to say, 1,600 metres at 9 km.; for the howitzer, 9º, that is to say, 1,450 metres at 8 km.

Thanks to the lightness of the carriage, to its balancing on the axle and to the construction of the trail (the laying handspike and trail handles), changes of objective, where there is great change of direction, may be made very rapidly with a trained crew.

(B) *Special Arrangement or Devices on the Mountain Guns*

The *tube* (figure c), having only to resist the transversal stresses of the firing, is limited to the bore proper: a rifled part, chamber and obturating surface (the seat for the cartridge case or the plastic obturator). It has a ring for the lifting bar a, a locking ring b, a catch for hooking the tube on the sledge c, a lug of the sleeve d, a lug of the hook of the locking lever e, the notches for screwing the tube into the sleeve f, the seat of the lifting bar g, the centring groove of the rear face of the tube h.

The *sleeve* (figure d), which bears only longitudinal stresses, is screwed onto the rear of the tube and bears all the parts of the breech. It also bears the front face and its centring groove a, the locking lever b, the spring sheath c of the locking lever, the lug d of the locking lever, the catch or hook e of the locking lever, the socket f of the lifting bar, the notches g for holding the sleeve on the sledge, the counterweight h, the guides i to hold the sleeve on the tube, the grooves j used for screwing the tube in place, the catch k for hooking the sleeve on the sledge.

Mounting the Gun.—The barrel is placed on the sledge by means of lifting bars, the catch of the front collar or ring is placed in its groove and the lug in its seat, so as to centre the gun in the middle plane of the sledge.

To put the sleeve in place it is sufficient, with the assistance of lifting bars engaged in the sockets made for this purpose, to put it behind the tube in such a way that the guides may be in front of smooth sections. After the locking lever has been turned forward, the sleeve is pushed as far down as it will go on the tube and it is turned the sixth of a revolution. During this movement, the notches of the sleeve engage with those of the sledge at the same time that

the threaded sectors of the sleeve, which have a threading of the same size, are screwed upon those of the tube and the hook or catch of the sleeve enters its seat on the rear of the sledge.

As soon as the sleeve has been screwed on, it is sufficient to push the locking lever back until its catch engages with the stationary catch. This movement screws the sleeve onto the tube, which is thus screwed tightly home.[7]

During the recoil, the handle of the lever is held firmly in position by the force of inertia and cannot rise.

Assembling the Howitzer.—The operation is practically the same, except that the sleeve is placed first on the sledge, onto which it is hooked by a hook or catch arranged in the opposite direction to that on the barrel.

Elevating (*the 105 Howitzer*).—The elevating apparatus is similar to that of field guns: a double elevation sector operated by pinions placed at both ends of the elevating shaft. Since the gun is short, the breech could be placed practically on a level with the trunnions of the chassis in battery position (Figure e). Then, in spite of the fact that the trunnions are so near the ground, the recoiling mass has the space necessary to recoil without hitting the ground, up to the maximum of the angle of 40º.

For stability at small quadrant angles of elevation, account has been taken of the fact that it is not necessary to use the maximum charge for short ranges, the gun receiving small charges. Moreover, the maximum charge can be used beginning with quadrant angle of elevation of +15º.

Aiming for Elevation (*the 75 Gun*).—The solution adopted for this problem is that of the *turning cranked axletrees,* which makes it possible to fire this powerful gun both with very small quadrant angles of elevation *without lifting the gun* and with large quadrant angles (40º) without any preparation or excavation of the terrain under the trail. This device, which has already been used in many Schneider guns, has always given satisfaction; it has been still further improved in the gun of the 1919 model.

The limits of elevation for the two laying positions are:

Axle low: from –10º to +22º;

Axle high: from +10º to +40º.

Therefore the limits of aim in elevation have a part consisting of 12º in common.

The change from one position to the other can be made in about one minute. In the low position there is a very simple safety catch to limit the angle of elevation mechanically so that it does

[7] No matter how hot the tube may become, the sleeve may be easily removed.

not become too large, and so as to prevent the breech from touching the ground.

The construction and operation of the crank axle are as follows (Figure h):

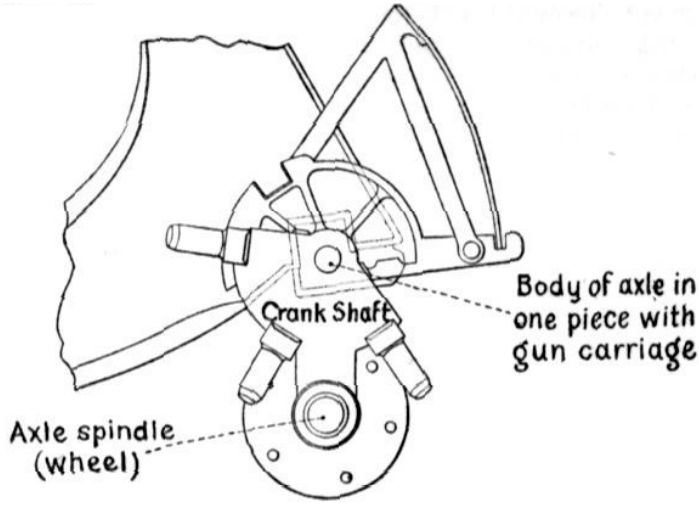


FIG. H.—AXLE HIGH

At each end of an axle body with a square cross section a grooved plate in one piece with the axle is attached. This plate has two grooves. On the projection of the axle body a crank shaft ending in an axle spindle turns.

On the inner surface of the crank shaft three spring cleats are attached, the

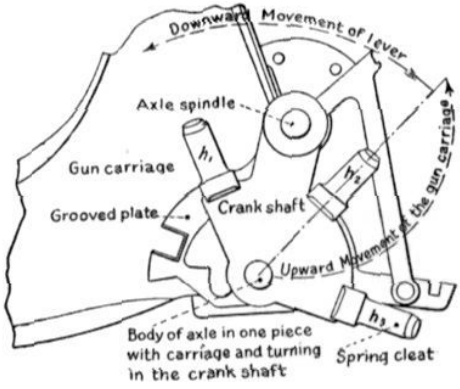


FIG. I.—AXLE LOW

spring pushing the cleat on the side of the fixed grooved place (Figure i).

To change from the position of "axle low" to that of "axle high," the gunners engage a lowering bar (lifting lever) in the stud

or lug of the rear cleat of each gear, taking care to place the cleat h_1 to the side and at some distance from the wheel to release it from the groove in which it is placed. Then the gunners at the right and left simultaneously move the two lowering bars (barres d'abatage) downward until the middle cleat h_2 automatically sets into the grooves of the fixed plate.

The operation is begun again twice more, the lowering bars being placed on the lugs of the cleats h_2 and h_3 successively.

The spaces between two consecutive cleats and the grooves of the plate are so arranged that only one cleat may engage at a time in the fixed plate.

The operation of passing from "high axle" position to "low axle" position is similar.

Taking the Gun Carriage Apart

The trail is broken in its middle (into two parts: front part of carriage and trail extension piece) (figures e to g and j).

The aiming sector can easily be lifted off the chassis,

CHARACTERISTICS AND NUMERICAL DATA

	Gun (Cannon)	Howitzer
Weight of the projectile ..... kg.	6,500	12
Muzzle velocity ..... m.	425	350 (maximum)
Maximum range shrapnel	7,800	
(Altitude 500 m.) H. E. shell	9,000	8,000
Length of the gun in calibres	18.5	12.4
Height of the line of fire ..... mm.	axle low 745 axle high 1,110	790
Width of truck	1,250	1,250
Diameters of the wheels	900	900
Limit of elevation ..... deg.	axle low —10+22 axle high +10+40	0 to 40
Limit of traversing ..... deg.	10	9
Type of elevating gear	Curved sight graduated in mils and in distances.	Of the Schneider type for guns with multiple charges.
Weight of the piece in battery ..... kg.	659	740
Thickness of the shield ..... mm.	4	4
Weight of the ammunition pack with harness ..... kg.	29	29
Weight of the pack of materials and harness ..... kg.	.36	36

and the rest of the sighting mechanism is borne by the front part of the gun carriage.

The shield (masque) may remain in one piece, the side plates of which are folded up as shown in figure j.

Transporting the Guns

Figure j shows how the 105 howitzer is taken apart and divided into parcels. Also see the table of characteristics.

The 75 gun can be taken apart and put into parcels as desired for its distribution among six or seven mules. In the first case the weight of the parcels or packages varies from 116 to 126 kg; in the

second case the parts are distributed in a different way into packages of about 100 kg. each with the exception of one whose weight is 118 kg.

The parts of the 105 howitzer may be distributed as desired in view of being carried by seven or eight mules. In the first case the weight of the

COMPOSITION AND WEIGHT OF THE LOADS OF THE MULES
(Not including pack-saddle and harness.)

No. of the package	Gun (Cannon)	Weight of the package in kg.	Howitzer	Weight of the package in kg.
1st package	Tube with covers	106.5	Same	100
2nd package	Sleeve with breech and covers	109.5	Sleeve without breech, with covers	101
3rd package	Chassis and sledge	118.5	Same	123
4th package	Front part of gun carriage, shafts	102	Same	123
5th package	Trail extension piece, shield for carriers	95	Trail extension piece and aiming device	102
6th package	Wheels, axles, box for aiming apparatus	111	Wheels, axles	90
7th package	Gun shield, lifting bars, aiming lever, fuse-setting machine	96	Shields	97.5
8th package			Shafts, lifting bars, breech in its box, fuse-setting machine, goniometer	81
Ammunition	2 chests of 6 rounds of shrapnel	122	2 chests of 4 rounds of shrapnel with charges	121.5
	2 chests with 6 rounds of H. E. shell and small boxes with detonator fuses	126	2 chests of 4 rounds of the H. E. shell, 4 charges. 2 boxes of detonator fuses	127

package varies from 90 to 123 kgs; in the second, the packages weigh about 100 kgs; two of the packages keep a weight of 123 kgs.

Transportation of the Pieces on Their Own Wheels

Both pieces may be very quickly transformed into a piece on wheels by folding the extension of the trail above the piece proper and by the addition of a pair of shafts.

The cart into which it is transformed is very well balanced and may be drawn over flat country over a short distance by only one man; on the road by one mule.

When the piece is on wheels in a travelling position, the 75-mm. gun may be placed either in position with "axle low" or "axle high." This latter position is particularly favorable when the gun is to travel over uneven ground and through high grass or over rocks.

2ND. SKODA GUNS

Skoda mountain guns, simple and primitive, were used by the Austrains during the war in the Vosges, the Alps, in Galicia (the Carpathians) and in Macedonia.

Although relatively heavy, they have given satisfaction to those who used them; on the other hand, they proved to be redoubtable

adversaries. Hence the Italians and Czechs have since the war armed their mountain artillery with Skoda guns. The Italians, in particular, "have wisely overcome the prejudices and useless sentimental complications,[8] and utilized the great number of 75 Skoda guns which they have taken from the enemy.[9] The Bonomi law, of the 20th of April, 1920, which sanctioned the new organization of the Italian peace-time army, provides that the three mountain artillery regiments should receive 75 Skoda guns and the armament of each field artillery regiment should comprise four groups of the Deport 75 guns and one group of 65 mountain guns (guns which previously formed the armament of the three mountain artillery regiments).

75 GUNS, 15 MODEL, SKODA TYPE

Gun (*Figures k to n and Figure 1 of Plate I*)

The gun tube, of special steel, has a sleeve. It is joined to the sleeve (manchon-lest) by a scarf joint. On its rear part the sleeve has the seat for the breechblock; the seat for the guiding connecting rod and that of the axle of the lever for operating the breech mechanism; the cylinder for attaching the gun to the brake and its screw; two carrying rings;[10] the guides which are an extension of those of the sleeve; the bolt of the firing lever, situated at the right underneath the sleeve.

The function of the attaching cylinder (cylindre d'attelage). The attaching cylinder is hollow, on the inside it has threaded sectors and smooth sectors, its cover is pierced with two holes.

It is attached by turning the cylinder one-sixth of a revolution; this movement engages the threaded sectors of the cylinder in the corresponding sectors on the end of the brake cylinder.

Position for Locking.—The bolt is at the bottom of its seat placed at the right on the breech housing; then it acts on a device which locks the transmission firing lever (levier de transmission de mise de feu) placed on the right side of the breech housing; the transmission lever is thus liberated and fire can be executed.

Unlocked Position.—The bolt is in its other seat situated to the left on the breech housing. The orifices of the cylinder cover are opposite the two ajutages on the brake which are used to fill and empty the latter.

[8] See in the Rivista di Artiglieria e Genie (Artillery and Engineers Review), January-February, 1922, the article entitled: Il riordinamonto dell'artigleria italiana. (Reorganization of Italian Artillery.) This article has been partially translated in the *Revue d'Artillerie,* volume 90, July 1922, page 85.

[9] The Italians generally designate the captured pieces by the initials P. B., which stand for the words "preda bellica" (war capture).

[10] Figure I represents the method of using these rings with the lifting bars.

Sleeve (*Manchon-lest*) (*Figure l*)

The sleeve (manchon-lest) supports the barrel and increases the weight of the recoiling mass. Its base has guides which slide on two slides on the cradle. The left guide is graduated and this graduation is continued on the guide of the breech housing or casing and thus it is made possible to measure the length of the recoil by means of an indicator on the left trunnion bedplate of the gun carriage (figure k and figure n).

Breechblock (*Figure m and Figure 1, Plate I*)

A. *Description*:

The breechblock, the horizontal wedge of the Skoda type, has, in its upper part: the operating lever and its counterlever, the articulated cam (finger).

On the right surface: The firing lever, the locking cam. On the rear and bottom of the firing lever is the groove of the locking bolt, which is on the breech housing, and a cam against which strikes a swell of the firing crank, borne on the cradle.

On the rear surface: The cylinder which covers the firing mechanism.

On the inside: (a) A spring stud which enters into a seating located on the lower part of the operating lever. This stud or bolt is integral with a rectangular frame which comes in contact with a cam borne by the shaft of the locking cam;

(b) In the centre, the percussion firing mechanism comprising: The cylinder which contains the striker, the striker and its spring, the cocking or releasing finger borne by the square nut at the end of the axis of rotation of the firing lever. The cylinder which contains the striker has a cocking ramp in which the cocking finger engages by a lug or stud.

B. *Operation:*

Safety Devices.—There is a double safety device: 1st, the firing lever is locked if the gun is unlocked; 2nd, the gun can be fired only when the breech has been closed.

Opening and Closing the Breech.—The operating lever operates the counter-lever which, in turn, operates the articulated cam. The counter-lever and this cam, reacting upon their ramps, push the breechblock in one direction or the other.

Percussion Firing Device.—At the moment when it is cocked, the firing lever pivots around its axis of rotation, which drives the cocking or releasing finger. The latter, operating upon the cocking ramp, pushes the striker backwards and compresses the percussion spring. The gun is cocked by the closing of the breech. At the

moment when the operating lever pushes down the spring bolt, the latter turns the locking cam which pushes back the firing lever until the cam falls into the stop notch on the firing lever.

The gun is fired by means of the crank mounted on the cradle; a swell on this crank knocks against the firing lever and separates it from the locking cam. At the same time the cocking or releasing finger leaves its guide on the striker bolt (porte-percuteur), the latter is thrown forward by the striker spring.

The departure of the projectile produces two movements which are the reverse of those described above, and at the same time releases: (a) the bolt which holds the striker (porte-percuteur) from the cocking finger or lever; (b) the operating lever of the breech from the spring bolt which the clamping cam forces to slide in.

Cradle

The cradle bears the hydraulic brake and the spring recuperator. It turns around two trunnions placed in the rear. The cradle is attached by special parts made for holding it on and placed on its lower part, 1st, to the muzzle counterpoises[11] which are on the gun carriage; 2nd, to the trunnion of the elevating are (figure n). On the upper part of the cradle are two slides or guides on which the guides of the barrel sleeve (manchon-lest) slide. On the right side are the firing crank and the controlling mechanism of the orifices of the recoil of the brake.

Device for Controlling the Brake Recoil Orifice

(Plate I, Figures 1 and 2)

This device is connected onto the right trunnion by means of a control casing (boite de commande) held firmly in position by two studs on the trunnion seating of the gun carriage and enclosing the following parts:

(a) A sliding tenon socket located inside the right trunnion of the cradle, which can move along the axis of the trunnion;

(b) A sliding socket or casing with a helicoidal ramp; this socket is firmly attached to the outside of the cradle trunnion and on the inside to the control casing (boite de commande);

(c) A regulating screw which is screwed inside of the sliding casing and ends in a fork. This fork embraces the head of a connecting rod or arm which operates a crank; the latter is in turn connected on a rod which turns in two bearings fixed on the cradle, one at the level of the trunnion the other in front. Over the extreme front end of the rod fits a toothed sector when a cap which contains

[11] As the oscillating mass turns toward the breech, muzzle counterpoises are necessary.

this sector is closed on the front of the chassis. In this cover the sector engages with a toothed wheel brought back by a spiral spring in the opposite direction to the movement which is imparted to it by the sector. On the inside of the wheel is a hollow part which has two slots. When the cover (capot) is closed, the toothed wheel fits over the head of the piston rod, on the end of which are two tenons (studs) which are placed in the slot of the toothed wheel. Thus the toothed wheel becomes integral with the piston rod.

Operation.—While the gun is being laid for elevation the right trunnion turns in relation to the casing (boite de commande) and the sliding socket, both of which remain stationary relatively to the gun-carriage. The sliding tenon socket turns integrally with the right trunnion, and its two tenons (studs) follow the helicoidal ramp of the fixed socket. As a result of this the tenon socket moves up to the right trunnion. When it pushes the crank which operates the rod, this crank puts the toothed sector in motion, and hence the toothed wheel. The latter turns the head of the piston rod in relation to the front plate of the chassis on which it is hooked. We shall see how this closes the recoil orifices of the brake.

Figure 1 of Plate I represents the device when the tenon-socket (tubular socket) has arrived at the end of its course (maximum quadrant angle of elevation).

The regulating screw, acting upon the opening of the recoil orifice, makes it possible initially to give the suitable advance or retard.

Recuperator and Brake (*Plate I, Figures 1 and 2*)

The *recuperator* consists of two concentric springs forming the telescopic whole characteristic of those made by the Skoda firm; this construction is similar to that of the French 65 mountain gun.

The inner spring compresses the outer spring and the sum of their flattening is equal to the length of the recoil, at rest, the crowding is reduced almost one-half.

The brake consists of a cylinder with helicoidal ribs and filled with glycerine. The piston head has a diaphragm to regulate the recoil and a cover for regulating the return to battery.

Operation (*Figure o*)

During the laying for elevation, thanks to the device described above, the opening of the orifice is varied in relation to the regulating opening in proportion to the inclination given to the cradle.

Recoil.—When the shot departs, the brake cylinder is drawn along with the barrel, the piston remains still. The operation of braking is gradual and more or less energetic at the beginning, depending on the initial dimensions given to the orifices (initial

adjustment and inclination of the barrel); therefore the length of the recoil is diminished in proportion to the inclination of the barrel.

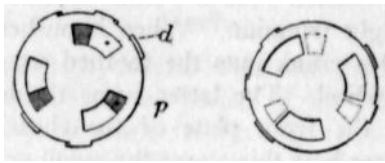
During the whole of the movement, the cover is moved farther away from the diaphragm by the pressure of the liquid, its ring hides the inside canals of the rod.

Return to Battery.—The piston-diaphragm type of device is closed, the diaphragm-cover type has open passages for the liquid to pass through.

The pressure of the liquid pushes the cover on the diaphragm, and the small openings of the collar or ring are brought opposite the canals of the piston rod. In the beginning of the operation of

PISTON-DIAPHRAGM DEVICE

Beginning of recoil. End of recoil.



DIAPHRAGM-COVER DESIGN

Beginning of return to battery. End of return to battery.

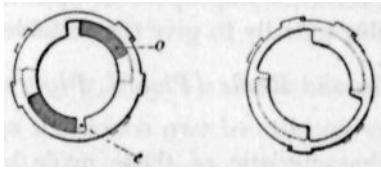


FIG. O.

return to battery, the liquid, to pass again in front of the piston, can only pass through the inner canals of the piston rod.

Then the rotation of the diaphragm increases the size of the orifice of the piston-diaphragm device, but closes one after the other, the passages for oil of the cover-diaphragm device. Hence there is graduated or gradual braking.

Gun Carriage

The gun carriage, of sheet steel, is made of two parts: 1st, the front part of the gun carriage which bears the elevating and traversing gears, the seat for the axle and the seats of the gunners; 2nd, the rear carriage, mounted on the front carriage by means of a hinge; it contains an extension of the trail cheeks of the front carriage and bears the anchoring spade. A gun shield in two parts may be placed in between the wheels.

Elevating and Traversing (*Figure p*)

The elevating gear is made up of two toothed sectors or arcs, the upper parts of which are extended by an arm which ends in a journal. Where the toothed sectors and the arms join in a cross piece which turns freely in respect to the toothed arc and serves as a point of support for the cradle. Each toothed arc meshes with a toothed wheel set on the elevating shaft which turns between the two side brackets of the front carriage. A system of gears protected by a casing on the right side bracket of the gun carriage controls the rotation of the laying shaft; the whole is operated by a crank; then the toothed arcs describe a circle (of which the arms are the radii) around the journals of the arms embedded in seatings on the gun carriage, beside the cradle trunnions.

The traversing gear moves the gun carriage, which pivots around the trail, along the axle. It comprises a sliding bar attached to the end of a ring or flange on the right of the axle; this bar passes through the elevating shaft which can slide on the bar mentioned above. A screw engages in a threading made on the inside of the sliding bar. A casing placed on the left side bracket of the gun carriage contains the trains of gears operated by a crank which give a movement of rotation to this screw. When the traversing screw turns, it pulls or pushes away the whole of the elevating shaft in relation to the supporting point taken by the sliding bar on the right side of the axle.

The laying gear is of the panoramic sight type.

Mode of Transportation

The matériel, transported on mule-back, is divided into seven loads, weighing respectively, including the harness:

Front gun carriage	146 kg.
Rear gun carriage	142.5 kg.
Cradle	143.2 kg.
Sleeve	143.5 kg.
Gun-body	150.2 kg.
Ammunition shield and aiming apparatus	142.4 kg.
Gun shield	143.3 kg.

Ammunition

The 75 Skoda Mountain Gun of the 15 model, fires a high-explosive shell and a universal shell.

The high-explosive shell is primed with a combination fuse and may be used as a time or percussion shell.

The universal shell (shrapnel shell) is filled with bullets of hard lead held in place by colophany. It is provided with an ogive filled with

GRAPHICAL RANGE TABLE. 75 SKODA GUN, 1915 MODEL, SCHRAPNEL—MODEL 1915.

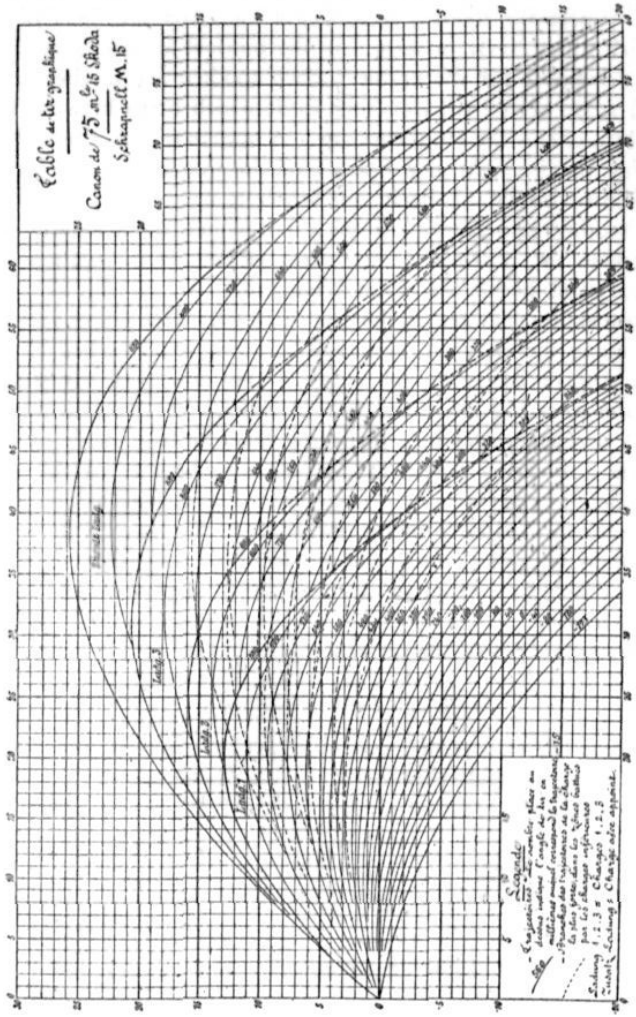


FIG. Q.—RANGE AND HEIGHT IN 100 METRES.
Trajectories shown thus———: The number placed above a trajectory indicates the quadrant angle of elevation corresponding to that trajectory, expressed in mils.
Trajectories shown thus- - - - - - - -: Are branches of trajectories of the strongest charge in the zones swept by the weaker charges. Ladung 1, 2, 3 = charges 1, 2 and 3. Zusatz Ladung = super-charge.

trinitrotoluene and bearing the combination fuse. When used as a time shell, the shell sets like a time shrapnel, while the ogive bursts like a shell at the point of impact.

The charge, which consists of three partial charges and one priming charge of black powder, is contained in a brass casing or a sheet-iron casing. When the fire is executed with reduced charge, the bags are wedged in by means of cardboard pieces.

THE 75 SKODA MOUNTAIN GUN, 15 MODEL

(Numerical Data)

1st. The Gun Proper

Length in calibres		15[12]
Number of riflings		30
Thread		Constant to the right
Depth	mm.	0.5
Width	mm.	4.24
Weight:		
Of the tube with breech		106 kg.
Of the breech		13.5 kg.

2nd. The Gun Carriage

Height of the step for firer kneeling (height of the trunnions above the ground)	706 mm.
Limit of elevation	Deg. –9 to +50
Limit of traversing	7
Length of the recoil	390 to 900 mm.
Initial tension of the recuperators	280 kg.
Width between wheels	900 mm.
Diameter of the wheels	800 mm.
Width of the tire	50 mm.
Weight of one wheel	25 kg.
Thickness of the shield	4.2 mm.
Weight:	
Of the shield	90 kg.
Of the gun-carriage with shield	514 kg.
Of the piece in battery	620 kg.
Distance between the axle and the trail spade	2.75 m.
Pressure of the trail on the ground, the gun being horizontal	40 kg.

Projectiles

Weight	6500 kg.
Muzzle velocity	350 m/s

Ballistic Data.—Figure q gives a general idea of all the ballistic properties of the gun, which have already been mentioned in Chapter IV (Table II, page 437).[13]

The 10-cm. Skoda Howitzer, 16 Model (*Figure r*)

The general construction of this piece is similar to that of the 75 gun which we have just described. It differs from the latter in the following points:

[12] In conformity with the Austrian custom of counting the length in calibres according to the total length of the gun proper. The length of the bore (rifled part and chamber) is 990 mm., or about 13 calibres. This is the figure which is used in the designation adopted by the Italians: canon de 75/13 P. B.

[13] See FIELD ARTILLERY JOURNAL, September-October, 1922.

The front gun carriage, of pressed steel, forms a front pintle carriage resting on the chassis.

The chassis, of sheet steel, comprises: the pivot of the front carriage and two axle seats, one for travelling position and the other for firing, the axle, wheels and trail-spade.

A shield placed in front of the wheels and bending backward, assures the protection of the gun crew.

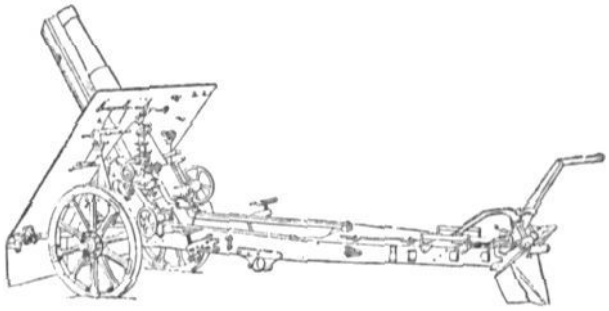


FIG. R.—SKODA 10-CM. MOUNTAIN HOWITZER, MODEL 1916

The piece is transported in three wagons or carts as follows: (a) one carriage track, hooked on to the gun carriage, the rear wheels of this truck being carried back toward the limber, and a system of shafts; (b) two two-wheel gun carts of the same model, one transporting the cradle, the other the howitzer proper.

The same ammunition is used for this howitzer as for the Skoda Field Howitzer, 14 model, namely: a shell and a universal shell. Weight: 16kg. Initial velocity: 340 m/s.

10 CM. SKODA HOWITZER, 16 MODEL

(Numerical Data)

1st. Gun Proper

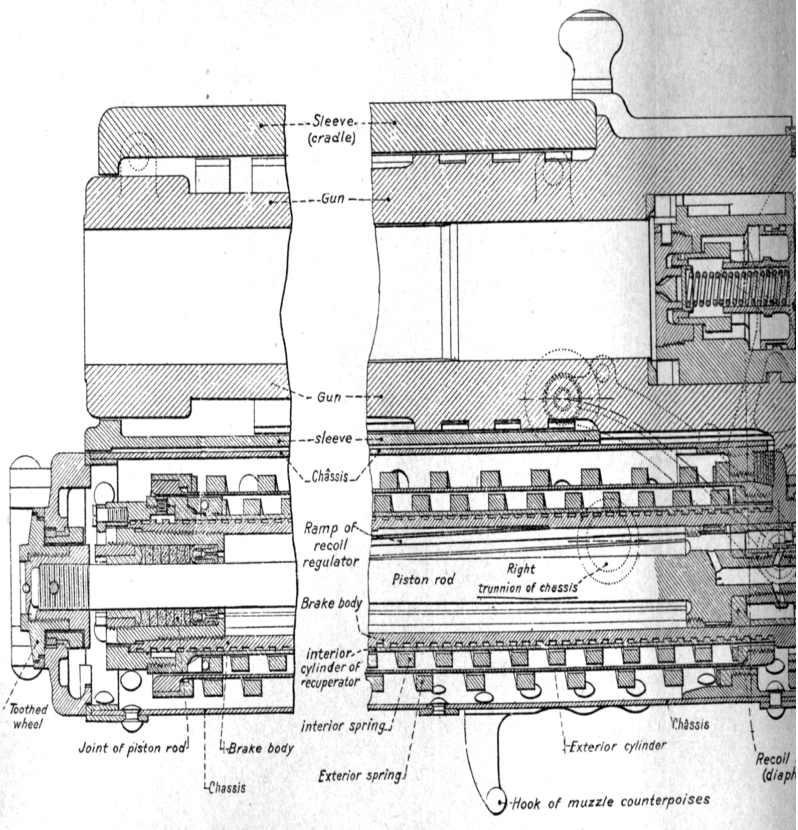
Calibre	100 mm.
Length in calibre	19[14]
Number of riflings	36
Threading	Constant to the right
Depth	1.1 mm.
Width	6.2 mm.
Weight of the tube with the breech	392 kg.

2nd. Gun Carriage

Height of trunnions above the ground	mm.
Limit of elevation	-8 to +70 degrees
Limit of traversing	5.5 degrees

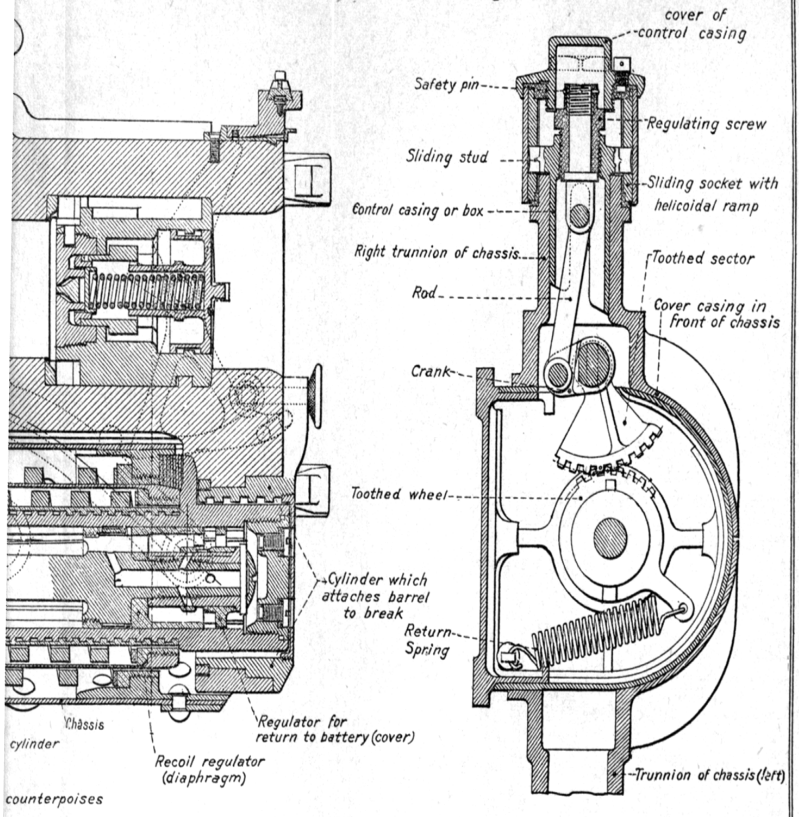
[14] See the note to the table on page 499. The length of the bore is 17 calibres.

Fig. 1. Mechanisme of recuperator brake



r brake

Fig 2. Device for controlling the orifices of the brake



Length of the recoil	580 to 1400 mm.
Initial tension of the recuperator	630 kg.
Width between wheels	950 mm.
Diameter of the wheels	900 mm.
Width of the tires	80 mm.
Weight of one wheel	45 kg.
Weight:	
Of the piece in battery	1235 kg.
Of the empty cart	290 kg.
Of the gun and limber	750 kg.
Of the wagon, cradle and shields	730 kg.
Of the carriage truck	670 kg.

3rd. Projectiles

Weight	16 kg.
Muzzle velocity	340 m/s

(*To be Continued*)

FIELD ARTILLERY IN REAR GUARD ACTION. THE HISTORICAL EXAMPLE OF DU PONT'S BATTERY

BY JENNINGS C. WISE, F. A., O.R.C.

THE influence of the European War with its unprecedented masses of field artillery must, in the nature of things, have a tendency to divert the mind from small units and to estrange our thoughts from a consideration of the importance of independent battery action. Yet, one who analyzes the story of field artillery in this greatest of all wars is compelled to the conclusion that there comes a time even in modern combat when the nozzle of field artillery fire must be directed, if at all, by the hand of an individual battery commander.

In this day and generation, however, the minute one turns to the war between the States, or some other great conflict of the past, from which to draw examples illustrative of the principles applicable to modern tactics, he runs the risk of losing the interest of his reader. Superficial minds, unable to analyze the experience of the past, see no permanence in those enduring principles which with respect to tactics are immutable. The past holds no lesson for them, but in the respect mentioned surely there has been little change. When the opposing lines break, when the enormous masses of the opposing armies pass from a stationary to a fluid state, the resolution of the battery commander who must hold off the pursuer, and the initiative of the battery commander who must with relentless vigor seek to breach the rearward screen so as to enable the pursuing infantry to reach the main body of the pursued and prevent it from stabilizing, play no less a part in warfare today than formerly, for in this phase of the combat, upon a broken and unknown terrain, a centralized control of fire, as distinguished from tactical direction, becomes impossible.

In retreat naturally strong positions continue to act as a magnet, attracting as they do from both flanks those who discover them, and this attraction of strong positions which is not exerted in a direction normal to the line of contact, inevitably tends to create lines of least resistance along which elements of an energetic pursuing force will flow much as water finds its way upon the surface of the earth. Unless the leaders of small units are able to discern these crevices in the rearward screen, and with ready and independent judgment stem the flow that threatens to percolate through them, the pursuing force will still penetrate the screen of the rear guard and thus

developing flanks, utilize the fulcrum of their positions to dislodge the rear guard prematurely from its delaying position.

Turning back to the history of the war between the States, we find some very brilliant examples of the way in which a single battery, handled properly, may even now be made to exert a decisive influence upon the fate of an entire army. Let us consider one of these.

In the spring of 1864 Grant planned to overwhelm the resistance of the Confederacy by combined strategy and simultaneous advance. In the West, Banks was to abandon Texas and move on Mobile; Sherman in the South was to destroy Johnston's Army, and Lee's Army in Virginia was to be assailed from every side. While the plan with respect to the operations in Virginia miscarried, we shall only concern ourselves here with Sigel's Army of the Department of West Virginia which was supposed to turn Lee's left by an advance to Lynchburg via the Valley of Virginia.

May 1st Sigel, who had at his disposal about 6500 men, commenced to move up the Valley from Winchester, believing that his advance would be unopposed save by a small force of cavalry under Imboden. On the 9th, however, he learned that Breckenridge with about 4000 men was hastening to the support of Imboden.

On the 14th Imboden was finally compelled to fall back upon the main body of the Confederates at New Market which is about fifty miles south of Winchester. Meantime, however, Sigel's Army had become strung out over a distance of nineteen miles, or from Woodstock to New Market, and in order to attack Breckenridge the head of Sigel's Army was compelled to fight with its back to the Shenandoah where there was but one practicable crossing. Indeed, at this crossing, the Massanutton Range with Smith's Creek at its base on the east, and the Shenandoah River, create what is no less than a tactical defile in as much as the Shenandoah, with high, precipitous banks, bends sharply southward at the point where it is spanned by the turnpike and thenceforth parallels both the turnpike and Smith's Creek on the east.

The inevitable occurred. Sigel, failing to deploy his full strength, was defeated in detail on May 15th by an inferior but collected force, and was thrown back in disorder across the Shenandoah. It was in this affair, a brilliant one on the part of the Confederates, that the justly celebrated Corps of Cadets of the Virginia Military Institute—a battalion of about two hundred muskets—broke Sigel's line by a charge which in point of sheer gallantry has, perhaps, never been excelled in warfare.[1]

But the exploit of the cadets was not the only instance of gallantry

[1] The New Market Campaign, Turner; The Military History of the Virginia Military Institute, Wise.

on the battlefield of New Market for as the eager Confederates, flushed with victory, pressed across the soggy fields in pursuit of the fleeing enemy, they were brought to an abrupt halt.

Forty-eight years after the battle of New Market Captain Benjamin A. Colonna, who for many years had been Assistant Chief of the U. S. Coast and Geodetic Survey, met by chance encounter Colonel Henry A. Du Pont, then Chairman of the Military Affairs Committee of the United States Senate. Colonna as a cadet captain commanding a company in the Corps of Cadets had engaged in the Battle of New Market, and upon learning that Colonel Du Pont had served in the Federal Artillery during the war, undertook to describe to him the superb conduct of a battery of artillery which had checked the Confederate pursuit at New Market of which he had been an eye witness.

According to Colonna, when Sigel's line was broken about 3 P.M., that portion of his army south of the Shenandoah took up a precipitate flight along the Valley Pike to the stone bridge, the Confederates pursuing vigorously in the reasonable expectation of capturing large numbers of the enemy at the crossing. But as the pursuers, with formations gone and units greatly intermingled, arrived at a crest some distance north of New Market, they found some Federal guns across their path which immediately opened fire with extraordinary precision of drill and aim.

"The service of these guns reminded me of the drill of our Cadet Battery," said Colonna. "It was different from and superior to the ordinary."

The smoke from the first few rounds hung so low and added so much to the obscurity occasioned by the haze of a cloudy day that it was but a few moments before the pursuers could no longer discern the dense column of Federal infantry and artillery streaming along the pike toward the bridge. Furthermore, it was some time before the leaders in the pursuit were sufficiently reinforced to justify an attempt to dislodge the guns that had checked them. Just as the attempt was about to be made the two pieces which had been firing galloped off to take up a rearward position while another platoon of the same battery, posted in echelon to the rear, resumed the fire, and so on until the pursuit was abandoned. Thus, even the hard pressed 54th Pennsylvania and the 34th Massachusetts regiments which had stood their ground the longest and were bringing up the rear of the fleeing column, escaped capture.

Colonna described in detail the gallantry of the Federal battery and that of its commander, and expressing surprise that Sigel had made no mention of the incident, remarked that he had often wished to know who the youngster was in command of the Federal battery. Oddly enough, the battery was Light Battery "B," 5th U. S. Field

Artillery, which on May 15th, 1864, was commanded in person by First Lieutenant Henry A. Du Pont, whom the speaker was addressing.[2]

But how came Du Pont's Battery into the position which has been described? Was it mere accident which enabled it to save Sigel's Army? Not at all. Du Pont made the opportunity. It came about in this way.

After being graduated at the head of his class from the United States Military Academy in 1861, he had been promoted captain in March and placed in command of Battery "B," though he had not received his commission in May, 1864. Assigned to Sullivan's Division of Sigel's Army, the battery had marched with its division on May 15th, halting about noon for the midday meal and rest after crossing the Shenandoah. The day was muggy with alternate sunshine and showers, and the horses, steaming warm, were showing distress. Upon halting, Du Pont, therefore, in accordance with the better practice, caused his animals to be unhitched before sending them to be watered. While they were watering in Smith's Creek, six or seven hundred yards east of the pike, Sullivan received an order from Sigel to send forward two batteries as rapidly as possible. Accordingly, the other two divisional batteries—Carlin's and Von Kleiser's—which were ready to move, were sent forward to New Market. Soon afterwards, a second order arrived directing Sullivan to bring up his infantry. Interpreting this order literally, Sullivan directed Du Pont to remain where he was.

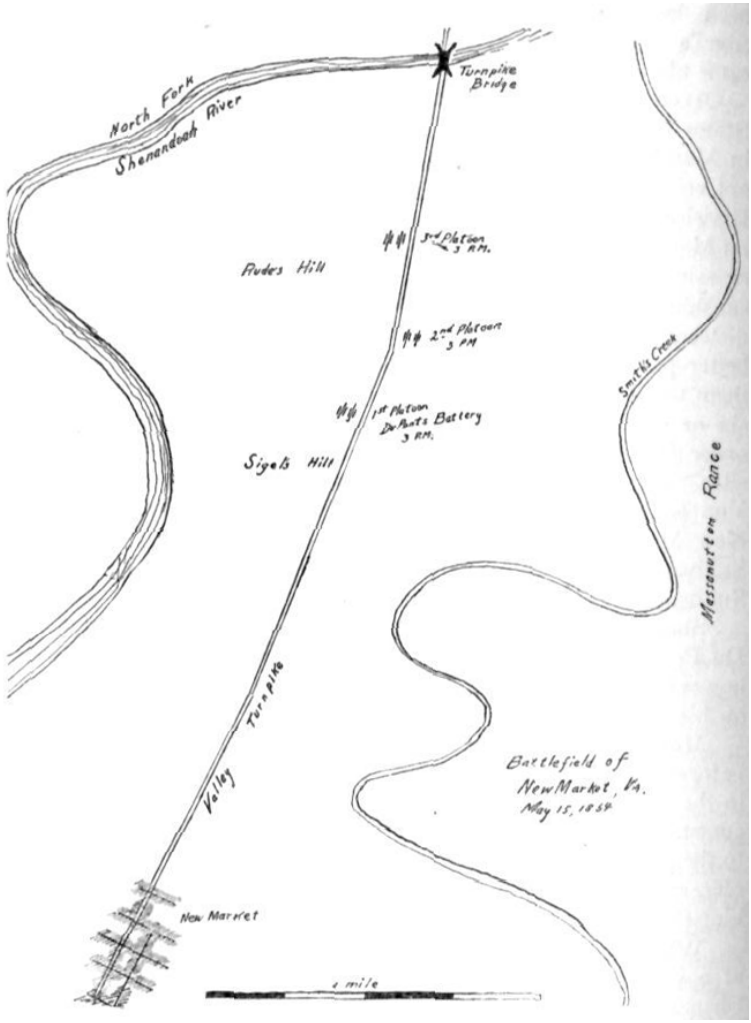
Shortly after midday the two armies became heavily engaged, Du Pont's Battery still being held in reserve on the pike. At last, however, he was ordered forward without the slightest knowledge on his part of the terrain or the situation in his front.

Moving off at a gallop he came upon the scene of conflict shortly before 3 P.M., only to find that the Federal Army was falling back in the utmost disorder and confusion. As is usual under such circumstances, numerous absurd and contradictory orders with regard to the posting of the guns were given Du Pont by irresponsible staff officers, but Du Pont, without hesitation, decided to take upon himself the responsibility of acting upon his own judgment.

While moving forward along the pike he had observed that at a point about two and a half miles south of the bridge, the Shenandoah River on his right and Smith's Creek with the Massanutton Range beyond on his left, narrowed to a distance of about two miles, the turnpike midway between. Here was his opportunity. Though the terrain was entirely open, consisting of pastures and fields planted in wheat and hay, and his battery was entirely unsupported,

[2] The Battle of New Market, Colonna, *Journal of the Military Service Institution,* Nov-Dec., 1912.

a heavy curtain of smoke hung between him and the enemy, not only obscuring the latter from him but his movements from them. Of this fact he decided to take advantage by so disposing his six guns in the narrow defile as to afford the maximum protection to the retreating army. Posting his



leading platoon (two guns) under Second Lieutenant Charles Holman in position close to and on the right of the turnpike, he caused it to open fire immediately upon the low-lying smoke which to his eye denoted the firing line, and then personally posted his second platoon under First Sergeant

S. D. Southworth on a slight eminence five or six hundred yards to the rear on the left of the road, while the third platoon, under Second Lieutenant B. F. Nash was ordered by him into position still further to the rear on Rude's Hill. Thus, having stationed his guns so as to enable his battery to retire by echelons of platoons upon the appearance of the enemy in force, he rejoined his most advanced platoon in order to direct its fire in person, and the better to carry out the retirement of the battery as planned.

Meantime, the Confederate Artillery consisting of McLaughlin's two light batteries, with ten of their twelve guns, McClannahan's horse battery of four pieces, and two pieces of the Cadet battery, was pressing forward east of the pike for the purpose of gaining a position from which to deliver a direct fire upon the swarming mass of refugees at the bridge. When, however, the pursuing infantry was compelled by Du Pont to halt upon reaching the crest now known as Sigel's Hill, the Confederate artillery in its rear was also brought to a standstill, finding only the fleeting target of Du Pont's shifting pieces the fire of which was so effective that in "Battles and Leaders of the Civil War" General John D. Imboden, of the Confederate Army, wrote:

> "When Breckenridge had pursued the enemy about three miles and had come in sight of Rude's Hill, General Sigel halted his batteries on its crest and began shelling our advancing lines. Breckenridge ordered a halt and stationed his batteries in an orchard, on the right of the pike, to return the fire. It was then perhaps 5 P.M."

For four hours Du Pont's battery, single-handed and unsupported, held off with its accurately adjusted fire the entire pursuing force, for it was dusk when in the course of its stubborn retirement it finally arrived at the bridge across the Shenandoah.

In General Sigel's account of the battle of New Market in "Battles and Leaders of the Civil War," it is declared that Captain Battersby's troop of cavalry were the last to cross the bridge. This is not correct. When Du Pont arrived at the bridge there was a small detachment of mounted men halted on the southern bank of the river to whom he sent his trumpeter to notify them that he intended to destroy the bridge, whereupon Captain Battersby led his men across and disappeared up the pike with them. Obviously, if it remained to the men of Du Pont's Battery to destroy the bridge under Du Pont's orders, Battersby can not be entitled to the credit given him by General Sigel.

General Imboden in his account of the battle declared that when Berkeley's Battery reached Rude's Hill the enemy's rear guard was crossing the bridge over the river, that it was too dark for

Berkeley to see the effect of the few rounds he fired, and that soon flames shot up from "dry combustibles that had been brought to the bridge and set on fire." He adds that the bridge was completely destroyed and further pursuit rendered impossible that night.

The account of Imboden is exaggerated. While the planking of the bridge was torn up and pursuit rendered impossible that night, the bridge was not "wholly destroyed," nor was there any fire such as that described by him. So thoroughly, however, had Du Pont done his work, so completely had he deceived the enemy as to the strength of the force which Sigel had left to cover the crossing, that not a shot was fired at him as he rode leisurely across the bridge, the last man of the Federal Army to cross the Shenandoah.

The speed with which Sigel's Army decamped from New Market is best proved by his own assertion that before 7 P.M. it was in position behind Mill Creek at Mt. Jackson, which is six or seven miles north of the battlefield of May 15th. If the Federal line did not break until about 3 P.M., it must have made a very rapid retirement! Then, too, it resumed its march at 9 P.M. When troops retire at this rate of speed ordinarily the retirement is called a route. At any rate, Du Pont's Battery, which did not reach the river until dusk, must have been far in the rear of Sigel's Army at all times during the late afternoon and evening though Sigel was apparently unaware of the fact.

Sigel's failure to mention Du Pont was, no doubt, not intentional, but due to poor staff organization. Du Pont's Battery was the only regular artillery unit in Sigel's Army and had had very little association prior to May 15th with that army. It was, therefore, a stranger in Sigel's Volunteer Army. Had there been a competent chief of artillery on Sigel's staff in all probability due notice of the services of the battery would have been taken. As it was, however, there being no one in Sigel's Army charged with responsibility for the artillery as a whole, it was not unnatural that the exploits of a single battery should be overlooked.

After the Battle of New Market Du Pont was appointed Chief of Artillery of Hunter's Army which, advancing up the Valley of Virginia, defeated the Confederates at Piedmont, and after demolishing the Virginia Military Institute at Lexington against the protests of Du Pont and others, proceeded to Lynchburg, whence it retreated into West Virginia. Later appointed Chief of Artillery of Crook's Corps, he was brevetted major for distinguished services in the battle of Cedar Creek and Fisher's Hill, and soon after brevetted lieutenant colonel for his conduct at Cedar Creek. In the latter battle in command of a battalion of artillery by his heroic conduct, he undoubtedly saved a large part of his corps from capture,

for which he was subsequently awarded the Congressional Medal of Honor.

In the "Long Arm of Lee," the writer endeavored to epitomize the lessons to be drawn from the operations of the Field Artillery of the Army of Northern Virginia as recorded in the "Rebellion Records." One who reads the story of Lee's Artillery today can not fail to perceive that there is much in it that will not only never flag in interest for the student, but that it enhances rather than diminishes in interest in the light of recent experience. And so it is in the case of the Union Artillery, the story of which, though not yet presented in collected form, is no less inspiring, no less fraught with glowing interest. The wonder is that the General Staff does not assign to those competent to perform it the task of writing a specialized and applied history of the artillery of the Union Army. Such a task is the legitimate function of the Historical Section of the General Staff. Yet, nowhere in our military literature are the lessons which are to be drawn from such an incident as that described herein, rendered available to the military student. And what are those lessons?

The conduct of Captain Du Pont at New Market as an act of personal heroism is laudable, of course, but courageous action is expected of a battery commander, and while admirable yields no particular lesson for the student of tactics. What interests the student most is the quick and independent judgment of this young officer, his instant appreciation of terrain, his initiative, his spirit of self-sacrifice, and his ready willingness to ignore the conflicting orders of superiors whom he perceived had no real understanding of the handling of artillery.

Great numbers of his own army were racing past him, almost frenzied in their desire to reach the bridge in his rear. Each group, we may be sure, had its own tale of disaster. Other batteries, most of which had suffered heavily and lost guns in the action of the day, mingled with the fleeing infantry, were dashing rearward past him. He knew nothing of what was in his front save from the alarming reports of the disheartened refugees. Of course, they tremendously exaggerated the strength of the enemy. On his right and rear ran a deep and unfordable river which could only be spanned at the bridge on the turnpike toward which the confused throng of men in retreat was making its way. On his left were the soggy pastures bordering Smith's Creek beyond which loomed the impassable barrier of the Massanutton. In his front the only target was an imaginary one—the disordered pursuers whom he knew were reforming under the pall of battle. But even as he threw his guns into action in order to create the delusion of a force in position,

the enemy was discernible filtering through the smoke around his flank!

He does not risk all his guns. Only two at a time, at most. As the disordered pursuers come up against these they are momentarily checked. Moments of delay are precious to the hard-pressed infantry on the pike. Many men may reach and cross the bridge in half an hour. He knows this. What matters the loss of a battery if this great mass of men and the other batteries of the Federal army can be saved? And, as the enemy, who at last have discovered what lays across their path, press on again, unwilling to be denied their rightful due without another effort, they find themselves confronted by still other guns, those which they had all but taken having eluded their grasp. Not from one, but from three positions, it now appears that the Federal artillery is firing. The dense smoke of Du Pont's guns and of the Confederate guns which are searching for them is more and more completely obscuring the view down the pike. Clearly it is not safe to push farther.

Thus is the pursuit arrested. The energy which it possessed and which would have carried it far unopposed is not sufficient to enable a new attack to be organized, for there is a limit to human endurance and will power.

To the west the glow of a brilliant sunset fades below the serried peaks of the Alleghanies. Out of the purple shadows a watery moon lifts majestically above the soaring crest of the Massanutton as if to scan with tearful eye the silent vales below. Along the ensilvered Shenandoah the smoke of battle and the rising mists mingling around the stricken fields. Far to the north Sigel's demoralized army—still unconscious of its security—impelled by fear of what lays behind, is pressing through the dark, while to the south the exhausted Confederates search the battlefield for their fallen comrades, rueing the fate that has denied them a fuller reward for their victory. Yet, the tidings of that victory bring joy to the heart of Lee. For the moment, at least, the indomitable army of Northern Virginia is secure.

And there on the Shenandoah, without orders, without communication of any kind with the army which he has saved and which has abandoned him, remains Du Pont with his gallant battery throughout the solitary watches of the night!

Such is the picture of what a single battery under an intelligent, courageous, resolute leader may do in still other wars.

THE DEVELOPMENT OF ARTILLERY TACTICS—1914–1918*

BY LIEUTENANT COLONEL C. N. F. BROAD, D.S.O., R.F.A.

PART II

CHAPTER IV. 1917

THE first event of 1917 was the German retirement to the Hindenburg line. This movement was designed to bring into practice the new tactics for which the Hindenburg line had been made and also, probably, either to delay the spring offensive, which was known to be intended in this area, or cause it to be made with less preponderating artillery.

The advance only lasted about a month but it was fruitful in useful lessons. This was due to the fact that it was a miniature campaign compressed into a small space of time and country.

The advance may be divided into three distinct phases.

i. The slow and methodical advance of a mass of artillery over cratered ground with the object of attacking a heavily wired defensive line.

ii. The rapid advance or pursuit of the enemy developing into advance guard actions against lines of villages.

iii. The reinforcing of the advance guards as they came up against the Hindenburg line, and eventual deployment of all the available artillery for the attack of that line.

The main lessons which we learnt were as follows:

i. The mobility of the heavy artillery was firmly established. Both in bad and good country it compared very favorably with the Field Artillery.

ii. The facility of ammunition supply decides the number of batteries to advance.

It is worse than useless to send forward more batteries than can be supplied with ammunition as it only increases the congestion and delays the other traffic.

It must be decided beforehand what amount of artillery will be required or how much the roads will stand. These batteries must be selected before the advance, the remainder being ordered to stand fast.

When the first rush is over, these latter batteries can be parked in suitable places and drafted forward as required and condiditions permit.

The importance of highly organized railway work, with broad

* Reprint from *The Journal of the Royal Artillery*, June, 1922.

and narrow gauge, came to light very forcibly at this time. The field artillery ammunition could be packed by horses; it was, at one time, a 15-mile pack to the guns. The heavy ammunition had to go by lorry with the exception of a few caterpillar trailers. Thus the rapid advance of the railway was essential, as the roads across the devastated area were not in a condition to permit of much lorry traffic.

It is of great assistance to traffic control, on single-way roads such as the Bapaume-Albert Road was at that time, if long advances are made by "blocks." These "blocks" consist of several batteries of similar pace. The road is cleared for them so that they can run quickly through.

iii. It was found that some heavy artillery should form part of an advance guard of any size. Furthermore the moral effect of 8-inch howitzers and 6-inch guns, even used singly, was very great. It was well worth while to get single pieces of this nature forward, as it gave to the advance troops a semblance of greater strength than they possessed; one of the most necessary functions of an advance guard.

iv. The principle of one artillery commander for all the artillery with a detached force such as an advanced guard, was clearly demonstrated. At the same time, he must be provided with an adequate staff from division or heavy artillery resources.

v. The holding power of the machine gun in open warfare was early established. Attacks on villages failed because it was difficult to discover where the machine guns were located. Only very limited fronts could be effectively barraged with the result that the attack was stopped by some unbarraged machine gun.

The opinion was formed, which still held in 1918, that once a line of hostile machine guns has been established and it has been found impossible to turn this line, then it is necesary to wait, in order to collect adequate resources in guns and ammunition. To attack prematurely is to court disaster.

vi. As soon as the deployment began to take place against the Hindenburg line, the importance of corps control became at once apparent. It is essential that the heavy artillery Commander and Counter-battery Staff Officer should get well forward as soon as possible, in order to watch the situation, keep in touch, and be ready to take over at the earliest possible moment; otherwise the hostile

artillery, in its carefully selected positions, may get a start which it will be costly to overtake.

vii. The importance of good coöperation between the infantry and artillery was of course manifest all the time, especially in the attack of the villages, when the artillery needed information from every possible source in order to locate the hostile machine guns.

The battles of Arras and Vimy were carried out on Somme lines and caught the enemy in his old formation and adhering to 1916 tactics.

A very great point was made of counter-battery work. The artillery intelligence was now a thoroughly going concern and the positions of the German artillery were very accurately known. The fire directed in accordance with this information was very successful in neutralizing the German artillery. Subsequent examination of the battlefield revealed a very small percentage of errors in the hostile battery list. This was a matter which was continually improving and led to remarkable results in the summer of 1918. Some batteries on August 8, 1918, were not even able to approach their guns after zero—the guns being captured with their muzzle covers still on.

The success of the battle of Arras and the German retirements further south brought us up against the Hindenburg system.

An examination of the portion captured at the battle of Arras and bombardment of the remainder disclosed the new arrangements of machine-gun defense in depth. This was the first definite indication we had of any change in the German defensive tactics.

The advance from Arras, up against an organized position, had also got us into difficulties with the German artillery.

Counter-battery work had now reached a stage when it was dependant on sound ranging, flash spotting and the artillery intelligence generally.

This was the first experience that these services had had of a considerable advance, with the result that they were all temporarily out of gear. Under these circumstances there is bound to be a difficult time from the counter-battery point of view, but much was done before the end of the war to shorten this blind period.

Many large attacks were made at this time, which were successful at first, but by the evening our troops had been driven, by hostile counter-attacks, from the ground gained in the morning. The attacks were supported by an adequate artillery and it was obvious that some very radical changes were required. The difficulty was, however, what to do.

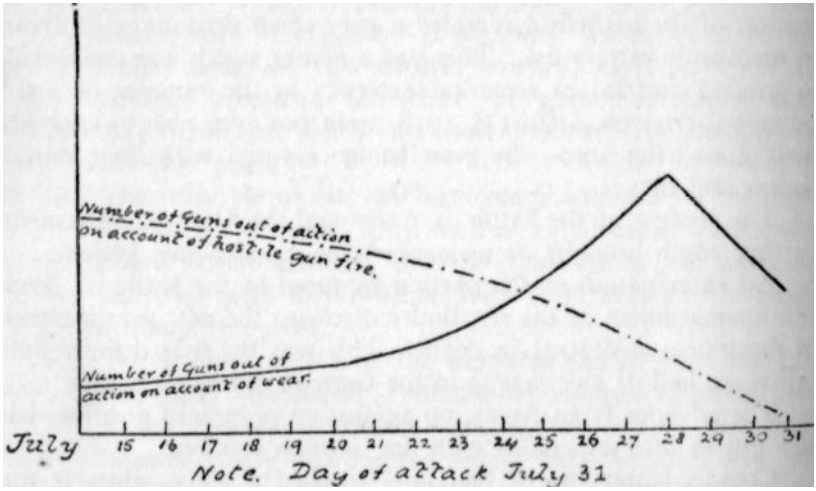
You must remember that at this stage nothing much was known of the new German tactics except their desire for more open

warfare and the machine-gun defense in depth. This machine-gun defense in depth led to protective barrages in depth, as it was found necessary to search the ground 2000 yards beyond the final objective, in order to subdue indirect machine-gun fire.

A small experimental tank attack was tried at this time in a place where the available artillery was inadequate for a barrage. The attack was made by 12 tanks and was successful at first; but eventually practically all the tanks succumbed to hostile artillery fire—foreshadowing, I think, the experience of 1918 when smoke for screening, and efficient counter-battery work were found to be essential to a successful tank attack.

The next event of 1917 was the Battle of Messines.

This battle is interesting on account of its early inception and careful preparations. Also for the first of the two big artillery duels ending in the defeat



and retirement of the German Artillery. Coöperation with machine guns had greatly improved and the machine-gun barrages were a feature of this battle.

The attack was made with a limited objective and the German special counter-attack divisions were not employed; so that no further developments in our tactics took place in this respect.

The next event was the battle of Flanders. This battle went on for several months without any pause in the fighting and was full of lessons.

The enemy had all the observation over the proposed battle ground. Few under features existed on our side of the line, so that flash cover practically did not exist. Cover from view was only provided by the somewhat rank vegetation in the hedgerows. The enemy's position was heavily wired.

A proposal was made to have a hurricane bombardment which

in view of the enemy's superior artillery position was very attractive. The strength of the hostile wire, however, made this proposal too risky an operation, so that preparations were made to cut the wire by gun fire, as was usual at that time. This automatically challenged the German artillery to the inevitable duel.

The hostile artillery had then to be subdued before the infantry attack could be launched. As many observed shoots as the weather permitted were made and large concentrations and area shoots were carried out. The latter were soon imitated by the enemy. For many days a ding-dong fight was carried on without visible result on either side. Towards the end of the month the hostile fire slackened.

The above graph was kept up from day to day, and illustrates the gradual subjection of the hostile artillery.

The two curves cross about July 25th. From that date the German artillery fire was very much less effective.

Towards the end of July the enemy evacuated, without orders, a large area of ground opposite the XIV British Corps, having been driven out by gun fire alone. An officer of the Prussian Guard captured at this time corroborated the curves of the above graph in his statements regarding the effect of the fire on the German artillery.

British counter-battery work at this time was definitely superior to the German in the following two factors:

i. Artillery Intelligence.

ii. Super heavy howitzers.

Information was now accurate and quick. The 12-inch howitzer was the best big howitzer on the Western Front.

The barrage arrangements were much simplified, looked at from the Somme point of view. We were no longer faced with deep highly organized trenches, so that it was unnecessary to pile up on the trenches; and generally speaking the barrage went straight across country.

The bombardment programmes were worked out in great detail. The matter was complicated by the fact that there was a good deal of hidden ground in the foreground which had to be taken on with aeroplane observation. Consequently very nice arrangements were necessary in order to prevent batteries spoiling each other's observation by unauthorized shooting.

The long-range guns were, throughout this battle, under army control. They were used as a rule on definite offensive tasks immediately before or during a battle.

The tasks generally resolved themselves into long-range bombardment of hutments and bivouacs occupied by reserve troops, or in forming a long-range barrage to interfere with the movement

of reserve troops or bus convoys. On battle days all the 6-inch guns and upwards were used on this latter task and it was sometimes possible to engage all avenues of approach.

All at first went well with the attack on July 31st. In the afternoon, however, we were driven back halfway to the starting line. The attack was renewed on August 15th with much the same results. Large advances to start with and little remaining at the end of the day.

There was fairly definite evidence that organized counterattacks, supported by fresh artillery, caused these retirements. This was a very different procedure to anything that had happened on the Somme.

Considerable changes were therefore necessary as the enemy succeeded in bringing fresh troops supported by fresh artillery against our infantry, weary after a long advance and either beyond or at very long range from their own artillery. Furthermore, there was a distressing paucity of dead Germans on July the 31st and the 15th of August, which pointed to the fact that the trenches had not been held very heavily. Every pill box had, however, its machine gun. We had thus practically got at the seat of the trouble when captured documents made everything clear.

The chief points in these documents are contained in the following extracts:

"In the case of the positions constructed hitherto with several continuous lines, the plan of the enemy is to destroy them at the beginning of a battle by the expenditure of great quantities of ammunition. The dug-outs situated in the old trenches were man traps and have often led to the loss of a large number of prisoners. These circumstances prove the weakness of the rigid methods of defence practised hitherto."

"The strength of the defence must lie in the concealment of our fighting force from the enemy's observation."

"As the destructive fire of the enemy proceeds the mass of the infantry is to be taken out of the forward trenches and dug-outs and to be echeloned in depth in the open before the first infantry attack."

"Shell-hole nests are to take the place of a trench line and are to be occupied by squads and single machine guns arranged chequer-wise over the area."

"A great part of the reserves and supports are to be accommodated in the open wherever cover from air observation exists."

"It is not sufficient that the infantry alone should be disposed in depth. The principles laid down must also be followed in the disposition of the artillery."

"The counter-attack in depth presupposes that strong reserves

of infantry have been stationed in the rear of the most important parts of the front, some three to five miles from the actual front line; a second line of artillery should also, if possible, have been organised from the mobile reserves of artillery."

"The situation, when the counter-attack has been launched, can be summed up as follows:

"The enemy's artillery does not know exactly where its own infantry is, and is therefore obliged to exercise caution. On the other hand, our artillery fire is more effective.

"It is noteworthy that the further the enemy penetrates into our position, the more favourable becomes the situation for the counterattack, as the enemy has not had time to consolidate the position."

It was proposed to deal with these points as follows:

Holding the Front System with Machine Guns.

It was decided to stop the trench bombardment as far as possible except where photographic evidence was available of actual occupation. The creation of a mass of shell holes was only playing the enemy's game.

Furthermore, it was decided to make considerable alterations in the attack barrage. It was our experience at this time that the enemy's artillery was only dangerous on battle days when—

i. Troops were forming up.
ii. During a long halt on subsidiary objective when the enemy had time to find out where our infantry were.
iii. When we had reached and settled down on our final objective.

The enemy's machine guns had, on the other hand, increased and attacks had failed on account of long-range machine-gun fire from the flanks as well as from behind the objective. A large portion of the counter-battery artillery was therefore brought into the barrage from about zero + 15′ and kept there as long as the infantry were in movement. Four separate barrages were formed and all except the 18-pounder creeper jumped about in an uncertain manner so as to mystify the enemy and catch him unawares.

Withdrawal of the Garrison.—The enemy could count at this time on our taking anything up to three hours to reach an objective 2000 yards deep. The enemy had thus two hours to move up for a counter-attack. He might do four miles in this time. Therefore the hostile garrisons might be living 9000 yards from our front line. It was decided to bombard, before the next attack, all places at long range which gave cover from aeroplane observation.

The Counter-attack by Fresh Hostile Troops.

This was the crux of the whole matter, and it was hoped that the alterations in bombardment would have shaken up their moral.

The enemy counter-attack was as much a set piece as our attack

and set in motion by our zero hour. We could therefore lay for it.

The conditions required to defeat these counter-attacks were:

i. The full force of our artillery must be available in positions from which it has been carefully registered.

ii. Our infantry must be well in hand and organized for defense in depth.

These conditions are fulfilled if the first objective is within 1000 yards of our starting line. The objective must be one that the enemy would want to take back and one that our infantry could reach in good order. Good observation facilities were also desirable.

It was our intention to wait on this position and fight the enemy on ground of our choosing.

It was possible to prepare a second or third objective to be carried out if the enemy was thoroughly defeated. His approach march was to be attacked by the heaviest possible fire, and positions of deployment well searched.

The battles of September 20th and 26th were fought on these lines, being preceded by a twenty-four-hour and two-hour bombardment respectively and were very successful, everything working out as expected.

October 2nd was fought on the same lines, but was not so successful.

It had been already appreciated that if the new arrangements made for September 20th were successful, then the enemy would have only two courses open to him, *viz:*

i. To bivouac his counter-attack division out of our range.

ii. To return to the Somme tactics.

The first alternative would make these divisions too late to intervene successfully in the battle. The second would again bring the German infantry under the full force of our artillery.

On October 2nd he appeared to have chosen the second alternative. A captured document stated:

"Frequently the counter-attack barely reached the line still held by us, suffered heavy losses and was quite fruitless, as the enemy contented himself with the objective gained. Experience shows therefore the necessity of holding the front line in strength."

We then returned to the Somme tactics and bombarded the forward area. The whole area was raked and swept in all directions. The appalling conditions of the ground made movement almost impossible to the infantry so that little advance could be made.

Nevertheless the enemy was again forced to change his tactics and made arrangements to put a dense machine-gun barrage along the whole front. The idea was to hold up our attacks and delay our defensive arrangements, so as to expose our troops to hostile barrage fire and the attack of the local reserves. The enemy had

definitely given up any idea of moving up counter-attack divisions. He succeeded in producing machine-gun fire of extraordinary violence, which stopped one attack. Our answer was to bring more guns into the barrage from counter-battery work and this particular trouble disappeared.

By the end of October the enemy had again reverted to holding the outpost system with posts arranged chequer-wise and keeping the reserve battalions behind his main line of resistance into which they moved when an attack started. He also at this time made his most effective move. On a code word (which was sent on a large attack being anticipated) the forward lines withdrew at an ordered hour within the outpost line of resistance. Fifteen minutes after this hour, or after our zero if it came before, the defensive barrage was placed on the enemy outpost line. This brought it down east of our leading wave, even if the hostile barrage was five minutes late. Our troops had then to pass through this, and attack the outpost line of resistance. The occupants of this line retired after fighting to the main line of resistance. A light signal was then sent up by the company commander in the main line of resistance and the hostile barrage was brought back to close in front of it.

Mud prevented the real testing of these tactics. In principle they are the same as those adopted by General Gouraud south of Rheims in 1918.

No satisfactory solution was found in 1917. The matter will be left here for the time being, as the whole question of defense is discussed in Chapter V.

The battle of Cambrai at the end of 1917 is one of the tactical landmarks of the war, for the following reasons:

i. Strategical surprise was made possible by the ability of the tank to attack a wired position without previous preparation.
ii. An accurate barrage was fired without previous registration.
iii. Secrecy in preparation and concentration was achieved and a tactical surprise obtained thereby.

These three points all contain the element of surprise which is perhaps the chief essential to obtain a tactical success; and from this time forward, surprise or deception in some form or another was present in all the major operations of the war.

Surprise and deception had really been the keynote of most of our successful artillery manœuvres up to the time of Cambrai.

The universal publicity, long before the event of our attack in Flanders, made apparent the absolute necessity of safeguarding the secrecy of intended operations.

Various measures to obtain this result were therefore introduced. The success of Cambrai was the first reward of these changes.

The attack on Lens in the autumn of 1917 provides a useful lesson, as it was made chiefly under machine-gun barrages. The lesson being, that provided sufficient fire power is developed the relative numbers of guns, machine guns, etc., does not materially matter. Therefore start your problem by deciding what volume of fire you require. Then build it up from your resources.

The principal lessons learnt during the summer and autumn of 1917 may be summarized as follows:

i. The rate of advance of an army is entirely governed by the pace at which a sufficient supply of guns and an adequate supply of ammunition can be got forward.

So long as the enemy has a portion of stout-hearted machine gunners and a supply of entrenching tools, so long will it be necessary for us to make use of large concentrations of artillery in supporting our infantry. Always provided that other means of overcoming the machine gun, which were not invented or obtainable in 1917, are not available.

ii. The value of surprise. Compare the heavy fighting on July the 31st at Ypres with Cambrai. The tactical surprise of September 20th was immediately successful where similar force but different methods had failed previously.

iii. Adaptability and versatility are essential to successful tactics. The data for these changes must sometimes be obtained by fighting but much can be done if the operations and intelligence branches of the staff really get together and constantly appreciate the situation, putting themselves in the enemy's position and using their imagination.

iv. The power of the machine gun both in attack and defense was further exemplified. Its power must be neutralized at all costs in order to bring off a successful attack.

v. To destroy the hostile artillery takes time and organization. Given this and the necessary strength, it is not necessary to worry about the hostile artillery on battle days. When previous firing does not take place as on August 8, 1918, the situation is, of course, entirely changed.

Success is then achieved by accurate information obtained before the battle, combined with an overwhelming volume of fire at zero.

Gas shelling definitely took its place in counter-battery work this year. The enemy were still ahead of us in the volume of this fire, which he produced, and in the possession of mustard gas. His use of the latter gas, in 1917, foreshadowed the tactics he employed in 1918, in forbidding

the use of certain areas to artillery altogether, by means of mustard gas.

vi. The unregistered barrage after 1917 became the normal procedure, and in 1918 became very accurate. Unregistered barrages had been suggested before Cambrai, 1917, but the state of training of the artillery generally, was not such as to warrant its use before this date.

Unregistered barrages naturally require to be simple in their conception. The infantry learnt in 1918 to give way, so that some feature marked on the map, such as a road, could form the opening barrage line. The barrage then dwelt on this line to allow the infantry time to close up to it before actually commencing the attack.

vii. Pace is an important factor in all attacks and should be as fast as possible consistant with keeping up with the barrage. Anything slower than 100 yards in six minutes precludes the possibility of a successful attack under ordinary circumstances.

viii. Ammunition expenditure showed the same tendency to increase as in 1916. Nevertheless the replacement of guns was now a much more difficult matter than the provision of ammunition. In this connection it is nearly always parts and spares, for which insufficient provision is made, and the present abundance of matériel should enable us to set up sufficiently generous standards for mobilization, in order to to stand the strain of the first weeks of the next war.

ix. The use of long-range artillery was more understood and had been brought definitely to help towards the immediate tactical objective.

x. "Stunts," for lack of a better word, are invaluable, but they must be continually revised else they fail to act.

xi. Battle harassing fire had defeated the German counterattack divisions, and had come to stay in the tactical repertoire.

xii. Close coöperation between machine guns and artillery had been shown to be essential to efficiency.

xiii. The railway work had grown out of all recognition. Masses of artillery can really only be kept in action by light railways and, therefore, these two subjects must be considered side by side when plans for operations are drawn up. These railways must usually be laid to suit artillery requirements and adapted for other purposes, as over 90 per cent, of their tonnage is ammunition.

A great danger lies in searching out the "lessons" of any operation, in that an attempt may be made to apply these lessons under

altered circumstances. The principle only is of general application; not the method.

Thus the form of the barrage, its density, its composition, etc., is nothing. It conformed to certain evolutions on the Somme. At Ypres it was entirely different, even at various stages of the battle. At Cambrai it was different again. In each case, however, the hostile machine-gun fire was sufficiently subdued to enable the infantry to advance.

Therefore each case must be considered on its own merits; the various solutions in the past, dealt with in these chapters, being only an assistance in formulating plans for the future.

CHAPTER V. 1918

The strategical situation at the beginning of 1918 was such as to cause a complete change in the tactical train of thought of both sides.

Both sides had become specialists, we in attack and the Germans in defense. During the winter the enemy studied the offensive and trained for the spring attacks. We commenced to study seriously the defensive.

We both very shortly had an opportunity of testing our opponent's tactical theories in the fighting which took place in March and April, 1918. Several points came up during this fighting, which led to a great deal of discussion during the year.

We are a conservative people and usually give way to innovations only when compelled by the force of circumstances. In the old days the young advocates of the new-fangled muskets referred to their senior officers as bow-and-arrow generals. Today the tank and machine-gun corps look upon the rest of the army in much the same light and yet we remain unmoved! So that in the course of a single summer it is not to be expected that any radical changes would be made.

Before considering the changes which might have been made, it is necessary to visualize the conditions under which defensive battles, like those in the beginning of 1918, are usually fought.

These are:

i. An almost certain numerical inferiority in guns.
   This precludes the dense S.O.S. protective barrages fired in 1916 and 1917 when the 18-pounders were 15 to 25 yards apart. Under defensive conditions there will usually be 100 to 200 yards to each 18-pounder gun.

ii. Uncertainty of the point of attack. Although the Germans in March, 1918, did not attack with tanks, our wire was not of sufficient density to necessitate any preliminary cutting. Consequently the strength of guns in action had to be further reduced to provide the essential reserves of artillery.

These reserves, with those of the other arms, will eventually stabilize the battle; but they will not prevent the enemy's initial success. The cost of this initial success to the defender will depend on the relative strength of the opposing forces. Consequently, the greater the disparity in strength between the two sides, the greater will be the proportion of troops to be held in reserve by the defense.

The tactical duties to be undertaken by the artillery under these conditions are:

i. Offensive fire action against the enemy's infantry and artillery during their approach marches, assembly and deployment.
ii. To assist the other arms to defeat the enemy's infantry in their actual assault.

In order to carry out the second duty, the artillery must be disposed in depth behind the battle position, since a successful assault of the front edge of the battle position would otherwise, either entail the capture of all the defending artillery, or cause a large portion of it to be in movement at the most critical period of the battle.

Furthermore, in 1918, from the artillery point of view, the front edge of the battle position could not be more than 2000 yards from our own front line; otherwise the defense had to choose between two alternatives:

i. Inability to reach the enemy with field-gun fire during his assembly.
ii. Reduction of the depth behind the battle position since, in order to reach the enemy's assembly, a portion of the guns must be placed in the outpost zone.

This distance of 2000 yards also fulfilled the condition that the battle position should be free from the enemy's mortar bombardment.

The same principle holds good today—the ranges depending on the equipments in use by ourselves and the enemy. The following diagram of a theoretical defensive position illustrates the above points:

Under certain conditions the outpost zone may be eliminated altogether, in which case the disposition and tasks of the artillery become simpler. The value of the ground either tactically, politically, commercially or morally will normally decide the depth of the outpost zone, up to the artillery tactical limit.

Successful instances of both extremes can be quoted from 1918. In April, the I. Corps defended the front line at Givenchy; in July General Gourod, south of Rheims, had an outpost zone of great depth. The Allied victory gained in this latter battle proved to be the high-water mark of the German successes in 1918.

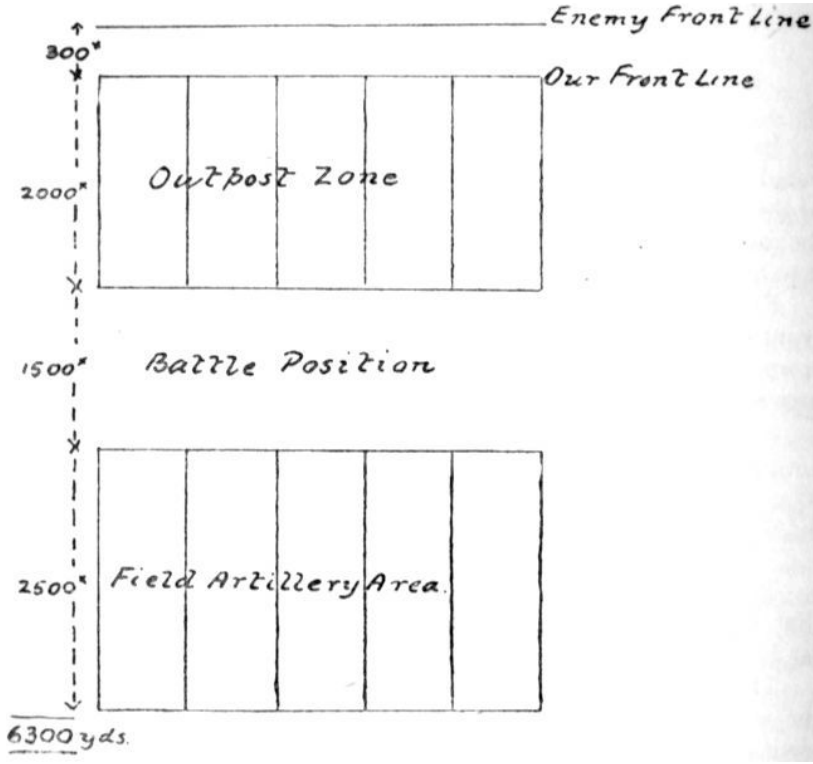
When the battle position is withdrawn from the front line

and an outpost zone exists, two courses of procedure are open to the commander.

He may—

i. Dispute every yard of the outpost zone to the utmost limit of the troops detailed to hold it.

ii. Withdraw all troops from the outpost zone before the hostile infantry attack, leaving it open for an offensive fire fight against the attacking infantry.



In both cases the main fight will be made on the battle position, but the artillery can be much more helpful in the second alternative than in the first.

As regards the three points already mentioned: The first one I want to discuss is the utility of the defensive barrage.

Our own experience in 1916 and 1917 had been that the leading waves invariably escaped the hostile defensive barrage unless the actual moment of attack had, in some way, been made apparent to the enemy.

A fixed defensive barrage, such as was used at that time, then became thin on account of counter-battery work or some such

reason; and disclosed avenues through which the supports could advance.

The German manœuvre at the end of 1917, in bringing back his defensive barrage in front of our leading attacking waves, deprived these troops of the advantage they had gained by making a surprise attack and forced them to go through the hostile barrage.

No satisfactory antidote to these tactics had been found by the end of the Flanders battle.

One disadvantage in this procedure is that the moral effect of giving up ground without fighting may be had. This is probably a matter of education, as it is really a question of the manner of your fighting rather than of not fighting. If the infantry soldier understands that the outposts are there purely for observation and repelling patrols, and that the guns and machine guns will attack the enemy with fire before the latter attack him; then it would be seen that his moral would be raised rather than lowered.

A combination of the two methods is possible if fixed redoubts are held in the outpost zone and the barrage is brought back round these redoubts or even behind them in such a manner that the redoubts themselves are free from fire.

This has the advantage of breaking up the infantry attack by rifle and machine-gun fire in the outpost zone, as well as forcing his leading waves to pass through our barrage.

In the case when the infantry are ordered to dispute every yard of the outpost zone, the mass of the defensive artillery fire must lie wholly outside this zone; since the incidents of the fight will cause our infantry to be scattered throughout the whole zone. Therefore, unless the outpost zone is definitely evacuated, either wholly or in part, by our infantry, it must be accepted as a basic fact, that the leading attacking troops can always escape the defensive barrage. These troops must therefore always be dealt with by the infantry themselves, assisted by the small amount of observed fire possible (from guns) under the smoke and dust of the hostile attack barrage.

The next point I wish to consider is the relation existing between counter-preparation, the defense barrage and the S.O.S. By counter-preparation I mean fire action against the enemy during his approach march—and assembly or deployment. By defense barrage I mean the intense fire opened at the moment of the hostile infantry attack. The S.O.S. should mean the same as the defense barrage, but is humanly bound to be associated with a large proportion of false alarms. In France it was also an indirect order to the artillery to fire on the defensive barrage lines; although the signal itself only meant that the infantry was attacking.

Now the defense barrage must be very closely associated with the defensive machine-gun fire. The number of guns at the disposal

of troops on the defensive will rarely permit of a thick barrage along the whole front. A thin barrage is worse than useless as it can be passed anywhere—this is undoubtedly so and, I think, is generally accepted.

Therefore the correct procedure is to allot certain portions of the front to guns and certain portions to machine guns when your available resources will probably permit of both arms concentrating their lines of fire to an effective density.

The defense barrage was usually placed as close as safety conditions permitted, in front of our most advanced infantry, in the hope that it might catch the enemy leading attacking troops. As has been shown above, this was a hope that could rarely be fulfilled.

Now the artillery tactics before the hostile infantry assault must be offensive, if anything is to be achieved. These tactics consist of firstly:

i. Harassing fire at long range against the enemy's routes of approach.
ii. Counter-battery work in suspected battery areas to destroy equipment and ammunition.

Secondly:

i. The attack of the hostile infantry assembly during the last few hours before zero.

As things were in 1918, this attack of the assembling hostile infantry, which, when we were attacking, was always the great fear present in everybody's mind on Y/Z nights, could be stopped at any moment by the premature use of the S.O.S. signal. Most of the artillery fire was then automatically taken from offensive action against the enemy's infantry to ploughing up an empty "No Man's Land."

The S.O.S. is very catching at a moment of strain and one signal will be repeated all along the line; it will run across a battle front of ten or twelve miles in a few minutes.

Also this signal is just as likely to be sent up five hours before the real attack as five minutes, and, in fact, in practice this has occurred.

It is therefore capable of completely nullifying any counter-preparation plans or programmes, which the commander may prepare.

On the offensive the S.O.S. was most effective in dealing with counter-attacks.

On the defensive, it is entirely out of place except in those isolated instances when the moral of the infantry is such that they require to hear our shell bursting just in front of them.

Even so, since the main fight will be made by other infantry held back on the battle position, it is contended that more good will be

achieved in the long run by attacking the moral of the hostile infantry rather than in any attempt to bolster up the moral of the front line outpost infantry who, after all, have only been allotted a subsidiary rôle in the battle.

This matter was being discussed throughout the summer of 1918, and the following solution was advocated:

The S.O.S. to be an information signal only; meaning that the hostile infantry are attacking, but not automatically entailing any immediate action by the artillery. On receipt of the S.O.S., fire would be turned on by the artillery sector commander as required. In battle, counter-preparation was not to be changed to barrage fire until orders were received from the rear. The rear commander, of course, being guided by the reports and signals received from the front line and by his own tactical knowledge.

He, of course, will have to be well up in a command post and will give his orders by wireless or light signal. Counter-preparation to be carried out by intense surprise bursts of all natures jumping about the probable assembly areas.

Barrage fire to be made as thick as possible by including all available guns of every nature.

The theory of these tactics is as follows:

i. The leading hostile infantry cannot be attacked with artillery fire immediately after zero unless the barrage is brought back. If this is not done, they must be left to the machine guns, Lewis guns, rifles, and counter-attacks by the infantry. At any rate, artillery fire is not wasted in abortive attempts to damage the leading hostile infantry.

ii. The weak spot of all attacks, *i.e.*, the assembly, is attacked in full strength right up to zero; as barrage fire will not be ordered till it is certain that the attack has taken place.

iii. The barrage fire, when put down, will be sufficiently thick to hinder the advance of supports, and the passage of runners back with information regarding any "soft spots" found by the attackers.

The third point I want to discuss is the control of the barrage fire after zero or after it has been put down. That is to say, when it is to be brought back and by whose orders, omitting, of course, the case when you bring it back as part of your plan, *i.e.*, the second alternative.

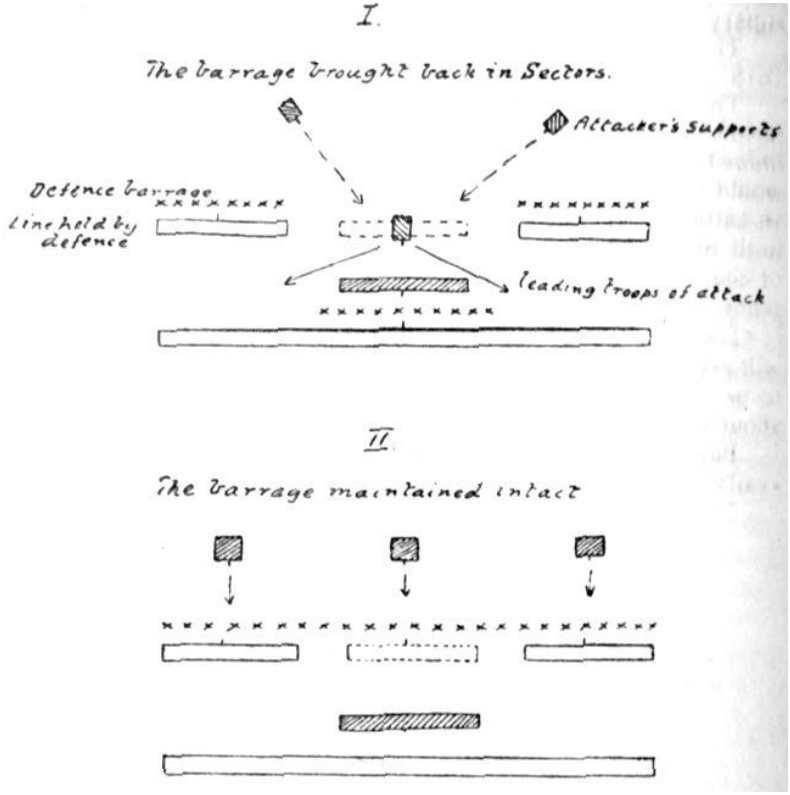
We have the choice of bringing it back in sections of increasing size by the orders of brigade, divisional or corps commanders or even of leaving it where it is until such time as our guns are forced to retire by the advance of the enemy's infantry.

The chief difficulty encountered is the total lack of accurate and timely information.

It is usually not known for hours after the event, that a certain line has been captured by the enemy.

Any attempt to order back the fire in sectors according to the progress made by the enemy in his attack, is therefore quite useless.

Furthermore, if the fire is brought back in small sectors, it merely



indicates the "soft spots" in our defense to the hostile supports.

Examine the two diagrams.

The defensive barrage should therefore not be put down until it is certain that the hostile infantry attack has commenced.

It should then contain all the guns available so that your full strength may be used against a target which it is possible to damage, *viz:* the hostile supports.

The barrage must make up for its comparative weakness by mobility, and work by heavy bursts of fire in ordered areas.

It may thus hinder the advance of the supports and generally dislocate the enemy's attack.

The leading hostile troops will not be strong enough to exploit,

without supports, any successes they may gain, and should thus fall an easy prey to our counter-attack in the battle position.

Nothing in the above, will, of course, be allowed to prevent batteries engaging hostile infantry with observed fire whenever opportunity offers. Under battle conditions these opportunities rarely occur and still more rarely can be taken advantage of, so that guns, temporarily removed from the barrage for this purpose, will not seriously affect it.

The chief innovations made by the enemy in his attacks were:

i. The movement of so many divisions, one behind the other. We had never dared to be so prodigal of troops or attempted to pass divisions through in the way he did.
ii. The enveloping nature of his infantry tactics, and the choice of certain routes of advance, and neglect of less favorable ones.
iii. The unregistered hurricane bombardment in an attack, against a wired position, without tanks.
iv. The control of the attack barrage from the firing line.

It is only the last two that concern us at the moment.

The surprise unregistered barrage dated from Cambrai and was carefully practiced all the winter of 1917–18 at the German Practice Camps. His choice of this line of action was tactically sound. It offered the great advantage of surprise, and our wire was such that almost any bombardment with instantaneous fuzes, would have made it possible for infantry.

We learnt, however, at Arras and other places, that an attack barrage cannot be depended on to cut the wire on rear lines, if it has been constructed in the strength usually employed by the Germans.

The success of this attack does not therefore, invalidate the statement that an attack, without tanks, cannot be made against a wired position, after a hurricane bombardment only.

The German orders for the attack in March, 1918, made an attempt to control the attack barrage by the leading attacking troops themselves.

Our experience in 1916 and 1917 was that an attack barrage must be fired throughout its programme for the following reasons:

i. The information on which any changes might be based, did not usually arrive in time for action to be taken.
ii. In those cases where information did arrive in time, it was considered to be sounder to allow all troops to go on as far as possible, in order that those who were successful might outflank such of the enemy, as were still making a local resistance. The danger in bringing back any fire, being,

that successful troops might be stopped by this fire or even destroyed by it.

The German idea was somewhat different as it was an attempt at the ideal, *i.e.,* the control over the exact front required by the people who were acting in coöperation with the fire.

We have no evidence that it was successful and we do not know that the Germans were dissatisfied with their barrage arrangements in the spring of 1918. We therefore retained our previous methods in our attacks in 1918.

The communications available in 1918 made the German ideal an impracticable proposition. Neither do the advances made up to date warrant its introduction. The complications involved rule it out on the axiom of simplicity.

We now come to the consideration of our own attacks in 1918.

We will consider these under four headings:

i. Preliminary arangements.
ii. Bombardments.
iii. Barrages.
iv. Pursuit.

The attacks are, of course, very full of lessons for the student, but do not show any great development in our tactics. The tank was still a comparatively new arm, and had not had time, as yet, to materially affect tactics.

The preliminary arrangements were kept secret. This had the added advantage that no bombardment was necessary. This automatically reduced the quantity of ammunition required and did away with the necessity for elaborate protection for both guns and signals.

Accurate map boards and careful resections of large numbers of battery positions made a heavy demand on the field survey battalions.

Great care had to be taken to conceal the dumping of the ammunition required for Z day. Careful arrangements had to be made for the assembly of the batteries and for the concealment of wagon lines, watering points, etc.; and for the artillery deployment at night.

It was found advisable to finish as much of this artillery deployment as possible by X/Y night, so as to save congestion on Y/Z night.

A great point was made of early issue of orders and no changes being allowed once decisions had been made.

As explained in previous chapters, the infantry were now prepared to give way as regards their starting lines for the attack, thus enabling barrages to be much simplified.

The artillery, on the other hand, allowed the infantry time to

close up to the barrage before the actual commencement of the attack. The actual barrage then went through as before.

Simplicity in tactics means speed in preparation, and usually efficiency in execution, and is therefore essential for open fighting. H.E. with 106 fuze for 18-pounders was much used for the same reasons.

It was found that bombardments were necessary before the subsequent attacks of any particular battle, *i.e.,* when strategical surprise was no longer possible.

No wire had to be cut as a rule, as the tanks did this; but it was necessary to cover the between-battle counter-battery work and to lower the moral of the enemy.

In certain cases forty-eight-hour bombardments took place, including periods of intensive counter-battery work and special gas programmes.

Barrages were fired in depth. Tanks helped with machine guns so that guns were released for counter-battery work. This is, of course, essential when the hostile artillery has not been knocked about by previous counter-battery work. Special counter-battery work is also required for the protection of the tanks.

In some battles as much as 60 per cent. of the available heavy artillery was employed on counter-battery work during the barrage. Smoke was often used in large quantities, partly to blind machine guns and partly to protect the tanks from anti-tank guns.

It was found, however, that the smoke tended to blind the counter-battery aeroplanes so that it interfered, at times seriously, with the counter-battery work, and also with the work of any planes detailed to observe the enemy's movements.

Smoke is, therefore, a matter to be carefully watched.

In examining the arrangements made towards the end of 1918 we must always bear in mind that the moral and fighting value of the enemy was rapidly declining, and therefore lessons deduced from these operations might lead us into trouble at the commencement of another war, when the same risks could not be taken with impunity.

The lessons of the pursuit do not differ materially from those of 1917, except that these operations provide many examples to be copied.

We find that machine guns still cause the deployment of large numbers of guns, and the dumping of large quantities of ammunition, before it becomes necessary for the machine guns to withdraw.

Our advance is therefore dependant on road and railway construction; and careful staff work is necessary to control the assembly, advance, and deployment of the masses of artillery matériel required.

This increases as the advance continues and we become dependant on long narrow lines of communication.

Where had we arrived then, by the end of 1918? The following points, I think, stand out:

i. *The study of the ground*.
This is the basis of all tactics. The massed attacks of previous years had rather obscured its importance. In 1918 we returned to the study of the ground and our main efforts were made in those localities where the ground favored us; the intervals being observed and concealed by gun fire. In the future this will be equally important.

ii. *Fire must be met by fire* and movement is only possible when fire superiority has been obtained.
The machine gun remained undefeated by the artillery to the end of the war, regarded in the light of comparative expenditure of effort. Nevertheless, the artillery remains, at present, the only arm capable of neutralizing the machine gun. Therefore an attacker must still outflank an enemy and so cause him to retire; or have sufficient artillery to neutralize the hostile machine-gun fire.

iii. *Counter-battery work* has become essential in all actions. We have seen the stabilizing effect of artillery fire on infantry continually on the increase throughout the years previous to the Great War, and especially since 1904. Innumerable instances can be quoted from every theatre of war where attacks have been squashed at their outset by a comparatively small number of guns. Therefore, if we hope to win battles with infantry, we must be able to neutralize the hostile artillery. This problem, as regards open warfare, had not been solved by the end of 1918.

iv. *The campaign of 1919* would have initiated what might almost be called a new era in tactics owing to:
(a) The improvements in actual battle coöperation by the Royal Air Force.
(b) The introduction of large masses of tanks.
(c) The improvements in all forms of communication.
(d) The increase in mobility owing to cross-country traction.

Lacking the impetus of war, the above items will all need several years of development in peace time, before they can seriously affect the tactical balance of 1918.

Nevertheless, these innovations would appear to contain the means of overcoming the difficulties left us in 1918, *viz:*

(a) The fire power of the machine gun on the defensive.
(b) The immobilization of the attack by gun fire.

Put shortly, the Royal Air Force may be expected to develop further efficiency both in close support of the actual attack and in counter-battery work. The tank may be expected to close with the defense and release guns for counter-battery work.

Wireless telegraphy in its future form, and wireless telephony, go a long way towards the effective neutralization of the hostile artillery.

Cross-country traction, once it is available in large quantities, frees an army from its roads and makes possible the quick massing of guns and ammunition.

This subject is, however, beyond the scope of the present paper and may therefore appropriately be left at this point.

In conclusion I should like to refer again to a few of the main points, underlying successful artillery tactics during the late war, since these must form the basis from which the artillery tactics of the future must evolve.

i. A good knowledge of the organization, capabilities and limitations of our various equipments, and their means of traction, both in marching and fighting, is required.

   The same applies to the various services auxiliary to the actual guns, Royal Air Force, observation groups, sound ranging sections, balloons, etc.

ii. The organization, equipment and tactics of the enemy, especially as regards the employment of his machine guns and infantry reserves, must be closely studied.

iii. Every new invention to improve the efficiency of the artillery must be seized upon and tactics evolved, to obtain the maximum value from it.

iv. In addition to the above, it is necessary in the field, to continually investigate the reason of things, and to combine this with clear and logical thought.

   The enemy's movements and intentions are thereby made apparent, and tactical surprise then becomes possible for the attacker.

   A commander will thus be in the position to obtain the maximum value from the force of artillery placed at his disposal.

Conclusion

CURRENT FIELD ARTILLERY NOTES

Ordnance Notes*

NEW SUSPENSION AND TRACKS FOR ORDNANCE AUTOMOTIVE VEHICLES

ORDNANCE automotive vehicles of the track-laying or caterpillar type have followed very closely along the lines of commercial construction. The track and track suspension of the commercial type of vehicle have, of course, been developed to a high state of perfection to fulfill the conditions under which they are required to operate. The track-laying vehicle for Army use, employing similar running gear construction, is called upon for much more severe service; for not only must the vehicle negotiate soft ground, where low unit bearing pressure is necessary, but it must also be capable of operating for long distances on hard roads at much higher speeds than are demanded of the commercial vehicle.

Operation on hard roads at comparatively high speeds requires that special consideration be given to the construction of the tracks and the track suspension in order to reduce to a minimum the road shocks transmitted to the running gear and the vehicle, which entail prohibitive maintenance. In addition there must be the minimum of damage to the roads and some comfort for the personnel riding on the vehicle. In the endeavor to fulfill these requirements the Ordnance Department is now studying the adaptation of chain and cable suspension and improved types of tracks quite different from the conventional construction. With this new type of suspension a continuous chain or cable working against a spring is used to equalize the motion of the bogies or trucks. Each bogie carrying two truck wheels not only has a verticle motion but a lateral swinging motion as well, so that the track can conform to the contour of the ground in two directions.

A special track construction is required with bogies having this lateral motion since the usual hinge point permits of motion in one direction only. With the present conventional construction the track is rigid so far as lateral motion is concerned and the side strain on the track and track supporting members when the vehicle turns is consequently very severe. To provide for a lateral movement of the track in conjunction with the swinging bogies the usual track link connections are made ball and socket joints with a considerable degree of freedom for both lateral and vertical motions. This ball

* Reprint from *Army Ordnance,* September- October, 1922.

and socket point construction also allows each link to assume a position on the ground independent of any other link, a degree of flexibility not possible with the usual type of hinge joint.

This new type of suspension, with the very flexible track, which provides for equality of the loads on all the bogies on a side, gives the track freedom of motion in a lateral direction without side strains on the track joints and supporting members, and allows each track shoe to follow the ground under it without strain on any other part of the track, offers possibilities for material improvement in the construction of track-laying vehicles for Army use.

ACCURACY TESTS, 75-MM. GUNS

Two 75-mm. guns, model of 1897, of French manufacture, have been given a recent test at Fort Sill in order to determine the effect of rounds fired upon accuracy, and the results as set forth in the following table are of particular interest in that there has been no apparent decrease in accuracy.

The two guns in question, Nos. 13688 and 14178, have been in use at Fort Sill for over four years, and it is estimated that each has fired over 20,000 rounds. The test consisted in firing these two guns in conjunction with two new guns, using the same lots of ammunition, the same range setting, and fired on the same day, in order that correction factors might be eliminated as far as possible. The point of fall of the shell was observed, and the probable errors in range and deflection were calculated.

At a later date the muzzle velocities were determined for all four guns, using the Aberdeen chronograph, but as the older guns were tested in May, and the newer guns in July, the difference in atmospheric

	Table Range	New Guns		Old Guns	
		20217	20053	14178	13688
Elevation	193	193	193	193	193
Range (yds)	5358	5380	5390	5294	5150
Average change in range (yds)	. . . .	+22	+32	–91	–235
Probable error in range (yds)	21	13.6	24.2	14	27
Probable error in defection (yds)	4	2	4.7	3.6	3.3
Muzzle velocity calculated from range	1755	1763	1767	1721	1668
Muzzle velocity measured	. . . .	1665	1666	1723	1707

temperature of nearly 50 degrees introduced a correction factor that in all probability was greater than was warranted.

From the above table it will be noted that the two new guns had a greater range than given by the range table, but the measured muzzle velocity without corrections was approximately the same as that muzzle velocity calculated from the range. The measured muzzle

velocity as determined from the old guns was determined under approximately the same climatic conditions as when these guns were fired for range, and it is to be noted that a very close agreement exists in the two figures for gun No. 14178, while a disagreement exists for gun No. 13688; but, as this latter gun had a loss in range of nearly two per cent. and a probable error in excess of that given by the range table, it is considered that this disagreement may actually exist.

The probable errors as given in the range table are 50 per cent. greater than actually determined from firing data at the Proving Ground. Therefore it will be noted that the actual probable error, as was determined when the range tables were made, is approximately the same as given for one of the new guns and old gun No. 14178. The above table seems to bring out, however, that in the condemnation of guns, care should be exercised in removing guns from a battery for wear until it is definitely shown that their accuracy has been seriously impaired, due to erosion.

ARMY ARTILLERY

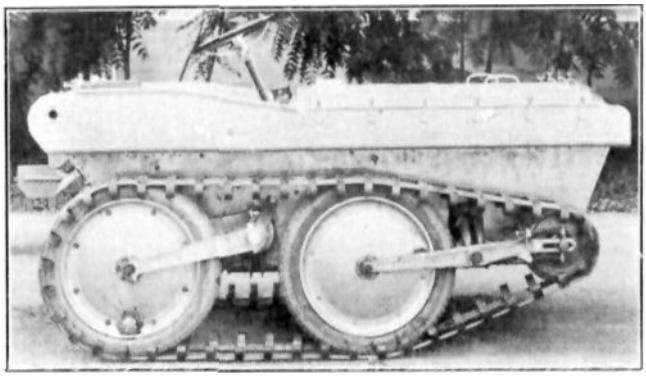
In the preliminary proof firings at this arsenal with the 155-mm. gun and 8-inch howitzer carriage, a muzzle velocity of 2,978 feet per second was obtained with a powder pressure of 44,240 pounds per square inch.

The carriage proved more stable at zero elevation with the 155-mm. gun than with the 8-inch howitzer as was to be expected, but will probably be satisfactory for both pieces throughout the ordinary ranges.

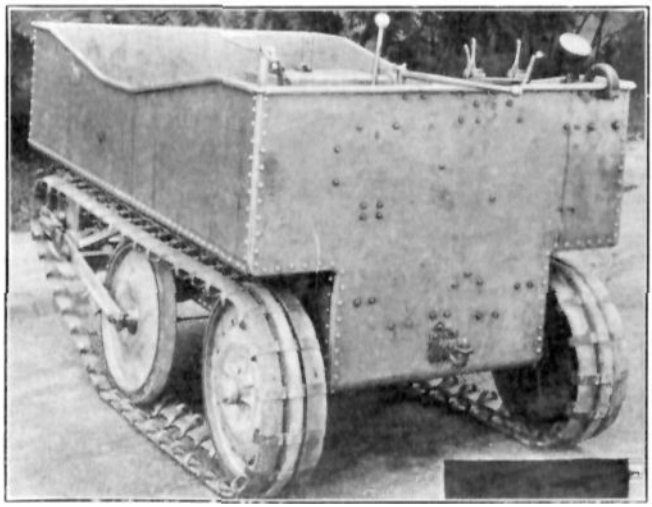
The following are the weights of sub-assemblies of the carriage with recoil mechanism for 8-inch Howitzer as:

	Pounds
Chassis, including axle, spring, brake mechanism, cradle lock, trail connection pins and axle pivot pin	4,181
Top Carriage, elevating and traversing mechanisms attached	1,590
Equilibrators (2)	830
Trail, right	2,019
Trail, left	2,027
Wheels (2)	1,916
Spades (2)	1,780
Recoil mechanism, with rockers and quick-return mechanisms (8-inch howitzer)	4,143
Total carriage	18,486

and the weight limbered with 8-inch howitzer is 29.137 pounds, of



800-LB. RECONNAISSANCE TRACTOR, RIGHT SIDE



600-LB. TRACTOR POWER CART, LEFT REAR VIEW

which 3,018 pounds is the limber weight and 557 pounds the accessories carried on the carriage. Other accessories for the carriage weigh 929 pounds which, with the spades, are to be transported on the supply truck.

RECONNAISSANCE TRACTOR AND TRACTOR POWER CART

Reconnaissance Tractor.—The shop test of the 800-pound Reconnaissance Tractor has been inaugurated at Rock Island Arsenal. The tractor body is made of duralumin and is waterproof and intended to float. Considerable use is made of Lynite castings for wheel bracket supports and similar parts. As shown in the photos the vehicle is supplied with propeller and rudders. The engine used in this reconnaissance tractor is a 4-cylinder, air cooled, Henderson motor. The Chase type track is employed.

Tractor Power Cart.—The 600-pound Tractor Power Cart which is designed as a cargo carrier is also constructed of duralumin and Lynite castings, principally. The body is waterproof and intended to float the vehicle. The cart is controlled by the operator who walks behind it and can operate the steering clutch and track brakes by pushing the lever, shown in the photograph, to the right or left. It is powered with a 2-cylinder, air cooled, Harley-Davidson motor. The Chase type track is employed.

THE UNITED STATES FIELD ARTILLERY ASSOCIATION

Annual Meeting

THE annual meeting of the Association was held, pursuant to the call of the Executive Council, at the Army and Navy Club, in Washington, December 27, 1922. The President, Major-General Wm. J. Snow, occupied the chair. The Secretary announced that a quorum for the transaction of business was present in person or by proxy.

The minutes of the last annual meeting were approved as published in THE FIELD ARTILLERY JOURNAL.

The Secretary read his annual report, printed below, which upon motion was accepted.

The committee appointed by the President to audit the Treasurer's financial statements reported that the cash books, vouchers, and cancelled checks had been examined and found to be correct and to accord with the financial statement presented by the Treasurer.

The Treasurer also presented a statement of the investments and other financial transactions of the Association during the year, which upon motion was accepted.

The Chair announced that a vacancy existed in the Executive Council, and upon motion Major Maxwell Murray was unanimously reëlected to the position.

An informal discussion of the affairs of the Association followed, after which the meeting adjourned.

ANNUAL REPORT OF THE SECRETARY

The hope expressed in the last annual report of the Secretary that better times and more settled business conditions would be reflected in the business of the Association during the fiscal year ended November 30, 1922, has not been fully realized, and the results of the year's work are not as favorable, from the financial point of view, as was expected. When the books of the Association were closed, however, they showed a small profit for the year. The total of the receipts of the Association was $9534.22, which, with the amount earned during the year but not yet collected when the books were closed, $276.39, makes the amount of the business for the year $9810.61. The expenditures amounted to $9326.74, or $483.87 less than the receipts, and this amount therefore is the profit for the year. A statement in detail of the receipts and expenditures is given below:

Receipts

Balance on hand December 1, 1921	$2,617.52		
Securities	15,000.00		
		$17,617.52	
Subscriptions to THE FIELD ARTILLERY JOURNAL	$5,317.05		
Advertisements	2,882.47		
Interest on securities and deposits	1,054.58		
Sales of books	89.98		
Miscellaneous receipts	190.14		
		9,534.22	
			$27,151.74

Expenditures

Publishing THE FIELD ARTILLERY JOURNAL	$5,720.17		
Miscellaneous printing	127.11		
Postage	169.60		
Personal services	2,306.73		
Office supplies and stationery	123.27		
Refunds	8.50		
Books	45.45		
Telephone	53.56		
Prize essay competition, 1922 prizes	250.00		
Articles and translations	79.00		
Office rent	300.00		
Miscellaneous expenses	143.35		
		$9,326.74	
Securities		15,000.00	
Balance on hand November 30, 1922		2,825.00	
			$27,151.74

The Association and THE FIELD ARTILLERY JOURNAL have received a reasonable degree of support from the officers of the Field Artillery Section of the Reserve Corps, but as heretofore has not received the support which could be expected from the officers of the National Guard. Cordial and hearty support has been given by about one-half of the officers of Field Artillery of the Regular Army; but the fact that only about one-half of these officers are members of the Association and subscribers to THE FIELD ARTILLERY JOURNAL shows a condition which ought not to exist in the

Army. All who are not members have been invited to join, some of them more than once. It is possible that this condition during the past year has been somewhat due to uncertainty as to the effects of the elimination law, and it is hoped that with more settled conditions in the military service during the coming year the condition may be materially improved.

A. F. CASSELS,
Lieut. Col., U. S. Army, Retired,
Secretary